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VOLUME 37 CHEMICAL & METALLURGICAL ENGINEERING NUMBER 7

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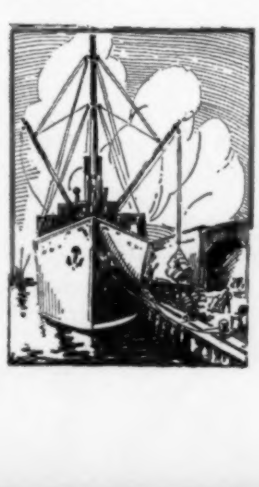
S. D. KIRKPATRICK, *Editor*

July, 1930

Chilean Nitrate Again Holds Center of Stage

AMERICAN chemical industries, and the American public as well, have a genuine interest in the drastic reorganization that is now under way in the Chilean nitrate industry. A new $365,000,000 corporation is to be formed in which the Chilean government will own approximately half of the capital stock. Participation in the corporation will be compulsory for all of the nitrate producers, who are to receive stock in return for their holdings. The Chilean government is to repeal the export tax, which has long been the major source of its revenue, and will also turn over to the new corporation 150,000,000 acres of undeveloped nitrate lands. In return the corporation guarantees to pay to the government during each of the first four years a fixed sum as a "dividend" on its shares. This amounts to approximately $22,600,000 for 1930 and decreases to about $17,000,000 in 1933. After that year the state renounces its right to priority treatment and will depend for any revenue on its income from shares in the new corporation. Thus the government definitely casts its lot with the nitrate producer and presumably will lend its influence in helping him meet the severe competition of the synthetic product.

FOR SEVERAL YEARS the production of Chilean nitrate has exceeded world consumption. Visible stocks mounted from 1,912,000 short tons in 1925 to 2,889,000 tons in 1929. Despite this fact, the industry has not been able, by self-regulation, to curtail production in accordance with demand or, by the most rigorous selling methods, to increase the demand to correspond with production. In the meantime, both European and American producers of synthetic nitrate and byproduct ammonia have been able to market their output at prices that offer severe competition for the best of the Chilean enterprises. In fact, it is questionable whether any but two or three of the Chilean companies can produce and deliver nitrate at Eastern seaboard ports at a cost which will permit sale in competition with American-made synthetic nitrate. The competition of ammonia nitrogen with nitrate nitrogen is even more severe and there is reason to believe that the present price differential is not likely to continue. Today nitrate enjoys, but perhaps does not wholly deserve, a premium of about 30 per cent above sulphate prices on a nitrogen basis.



IT MUST BE remembered, too, that the supply of the synthetic product can be expanded indefinitely as long as attractive markets are available. In fact, it is to the outstanding credit of chemical engineering in America that our industry has outstripped even the foreign synthetic industry despite the greater unit cost of labor and of certain raw materials.

ALL OF THESE facts would seem to indicate that the American public is effectively served in so far as it has any interest in nitrogen products. An unquestionable military security has been established; an adequate industrial supply of nitrogen is assured. Costs to the users are continuing their downward trend. The only serious prospect, as far as the general public is concerned, lies in the possible sale of additional Chilean nitrate bonds in the United States. Presumably such an issue could be largely sold on the American market, because the participation of the Chilean government implies to uninformed investors a degree of security that is not real. If they are sold, however, it may well be that the American purchasers of such securities will be the ones who actually lose most financially through the ultimate collapse of the Chilean nitrate industry.

EDITORIALS

Are You Preparing For Better Business?

BUSINESS WEEK is the authority for the statement, printed in full elsewhere in this issue, that the trend of general business has again started upward and by October will be back to normal. Chemical industry as a whole was equally as prosperous during the first half of the current year as in the corresponding period of 1928, a record year, although not up to the first six months of the abnormal year 1929. There is every indication that the steady expansion in the chemical industry that has been going on for a decade or more will continue. Alert producers are showing by their expansion programs that they recognize the healthy condition of the current chemical business as well as the prospects for much better years just ahead. One company alone is spending nearly thirty millions in extending its production facilities. Executives of other chemical concerns must not allow the fatalistic pessimism so prevalent today in other industries to blind them to the healthy condition of their own industry. Surely, this is the time for level-headed executives to get their plants in shape lest the return of better business take them unawares.

Our Technical Heritage Finds Visual Expression

SUCH visitors to Europe as circumstances or appetite have lured to Munich will soon find solace for the exigencies of travel that have deprived them of a more leisurely familiarity with that unique "microcosmos," the Deutsches Museum. Not that Oskar von Miller's grand concept, in this embodiment, can ever suffer a declining interest and eminence because of the propagation and development, elsewhere, of its idea. But in ever-restless Chicago a similar project is now substantiating on an even vaster scale; and within a very few years—by 1933, it is hoped—Americans can experience the past and present workings of technology within a showplace of their own.

The Chicago Industrial Museum, as it is now called, really sprang into being in 1926, when Julius Rosenwald, fresh from a visit to the new Deutsches Museum, enlisted the city's leading industrial and business forces to support his initial endowment of $3,000,000 toward a similar project for America. With surprising readiness, considering the non-commercial objectives of the idea, an enthusiastic sympathy arose in response to Mr. Rosenwald's proposal, so that by 1929 the essential constituents of a museum—building, exhibits, and ingenuity—were visibly materializing. The city of Chicago is rebuilding in permanent form the enormous Fine Arts building, left over from the Exposition of 1893; industry is contributing exhibits and funds for purchases; and the directorate, under Waldemar Kaempffert, is resourcefully assembling the contributions to display the technical ascent of man in the most graphic and compelling terms.

Whatever direct commercial justification expensive museums may or may not offer as a living historical record and inevitable stimulant, the new Chicago museum will undoubtedly surpass any similar serious institution in showmanship—and hence in general education. Chemical industry, for example, will necessarily command a large measure of attention: old laboratories, historic objects, obsolete processes, newer commercial processes, and finally the important developments that are still "news," will be so displayed as to make the visitor an integral part of each stage and of the whole historic movement.

Neglecting the intangible commercial benefits again, it is especially gratifying to note how generously the large industries have contracted to supply expensive exhibits. No special publicity has attended their efforts and outlay, which are thereby on the same plane as other types of educational contributions. And the educational effects, though not exactly comparable, should equally justify the outlay. While the Chicago museum will not offer a thorough, specialized knowledge to anyone, an unlimited number of the intelligently curious will be taught by condensed graphic experience. They will be in understanding sympathy with the activities to which they have been only distant spectators. And their fellows, pursuing some technical occupation, will stand to gain even more vitally from a glimpse into correlated industry—from a view of the woods in which they are a tree.

New Uses Would Solve This Problem

PROOF is accumulating of the impracticability of the rubber plantation industry's schemes for restricting its output. The Stevenson Act and the "May Holiday" in rubber tapping agreed upon by British and Dutch producers in the East Indies have ostensibly failed. At the close of the latter restrictive period, the price of crude rubber futures sank to a new low record and showed that such measures are impracticable, since two-thirds of the total acreage planted in rubber is controlled by natives whose co-operation in a common policy cannot be relied on.

Among several solutions for the plight of the plantation industry, the chief one is the lowering of the costs of production. This possibility is demonstrated by the progress made in recent years in deep tapping, bud grafting, seed collection, and other scientific developments. These refinements may very well increase the 400 pounds yield per acre of the plantations to a point where it will surpass the 800 pounds obtained by the natives. Too, rubber produced on the estates is of higher grade, due to scientific methods of cultivation. This advantage should be impressed upon the rubber buyers by organized propaganda and salesmanship.

Perhaps the most worth-while solution depends upon the development of new uses and applications for rubber. Sir Harold Snagge, of the Malakoff Rubber Estates, has well said: "If all the time and thought which for years were devoted to limiting supplies of rubber had been applied to promoting demand, the industry would have been farther along the road than now."

Sodium Sulphate Demands Attention

GIVE A THOUGHT to sodium sulphate. Salt cake is no longer produced in large quantities as a byproduct in the manufacture of muriatic acid. New processes have taken care of that. Nitric-acid works no longer put so much nitre cake on the market, for there is no such byproduct in the present-day processes of ammonia oxidation.

Yet the demand for sodium sulphate is constantly increasing and will continue to increase if producers and consumers awake to the possibilities of the natural deposits. Kraft paper mills in the Pacific Northwest find it worth while to use European salt cake, because of lower prices and the difficulties in obtaining an American product. Glass forms a large potential market for sulphate, because its use improves quality and durability and allows the addition of larger amounts of silica to the melt.

Canada and the far-Western United States have great deposits of the natural sulphate. It is reported that a new Canadian plant shortly to be erected will supply 36,000 tons of sodium sulphate in its first year of operation. Another potential source of material so far overlooked is in the waste double salt, burkeite, now discarded in great quantities by a large chemical producer operating one of the desert lakes in California. Burkeite consists of sodium sulphate, sodium carbonate, and water in molecular proportions. Obtainable in a fairly pure state, it should have great possibilities for the kraft pulp and glass industries, which can use directly this sulphate-carbonate mixture. The technology involved in production would not seem to be particularly complicated and the old bugbear of high freight charges may be offset, in part at least, by the increased tariff protection provided in the Act of 1930.

Excessive Pension Commitments Often Ignorantly Assumed

PENSION systems for retired employees are highly desirable. They make possible efficient management and the retiring of superannuated employees without ruthless or harsh treatment of worthy workers. To be safe, however, such systems must be based upon sound actuarial experience.

Ofttimes, companies recognizing the desirability of a retirement system establish some scheme that at first sight seems logical, fair, and economical, without carefully counting the cost for the future. Even some very great corporations of a quasi-public nature have fallen into this error. Subsequently such an administrative mistake brings an alarming series of consequences with financial burden far greater than anticipated.

Chemical engineering industries have been relatively young and vigorous. They have often been so vigorous as not yet to feel the need of any pension system. This is perhaps mentally comfortable for the executive, but it is not a permanently safe attitude of mind. Such concerns should promptly investigate both the possibilities and the costs of such systems. In their investigations they should use competent, experienced actuarial service. They should figure the cost not only for next year and five years hence but for the more important period, twenty to thirty years ahead. They should frankly face the necessity for setting up retirement reserves of adequate magnitude to care for the future burdens. Actuaries can tell just how much will be needed as soon as they know what system of retirement compensation is proposed.

Chem. & Met. believes in such programs; but it also raises a word of caution against thoughtless adoption without careful forecasting by thoroughly competent advisers. The cost can be made reasonable only when spread over many years by proper reserve charges. When so handled the burden is not excessive. Indeed it is only a reasonable and proper social burden to place upon any commodity.

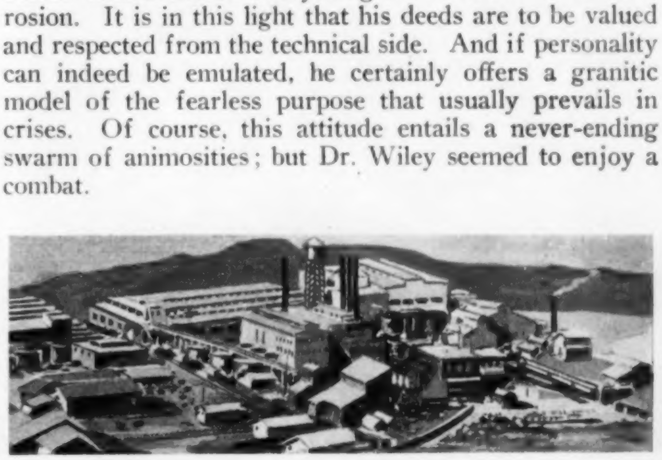
Straightforward Dealing With Government Bureaus

MANY of the executives of our industries have obtained a wrong impression as to the most effective method for dealing with government bureaus. Rampant yellow journalism seems to have given them the idea that nothing but political approach or some equally subtle special procedure will serve when they have business arrangements with the federal agencies.

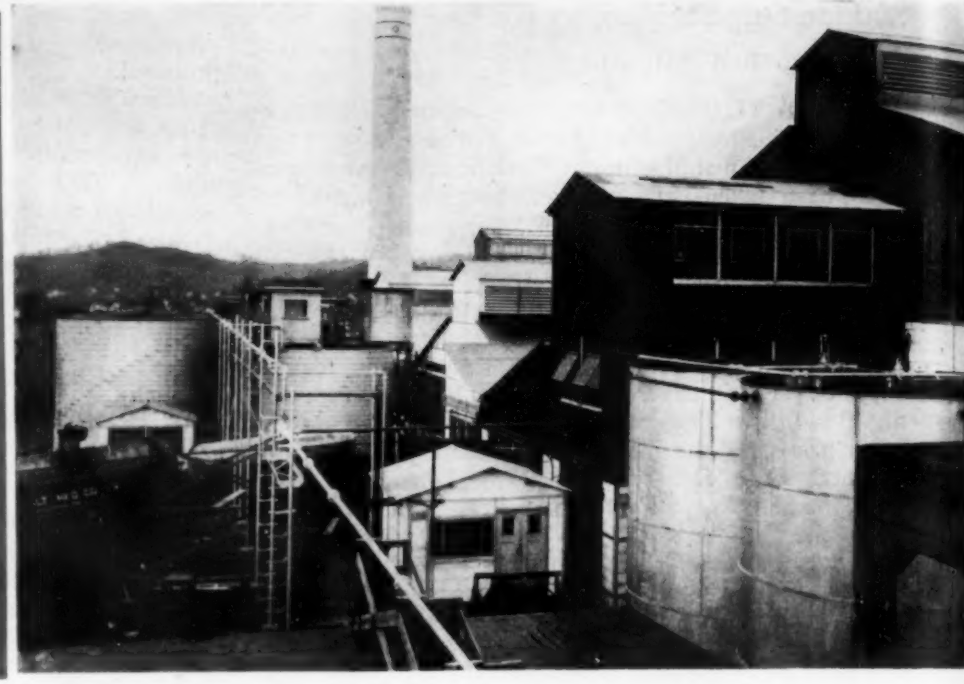
This is not a correct understanding. Dealings between industries and the departments and bureaus of the government can be carried on in a simple, straightforward business fashion. It is wholly unnecessary to run to some Congressman or Senator; in fact often it prejudices one's cause to do so. A simple letter, just such as might be written to any other business executive, commonly will serve for communication with the government offices for the transaction of ordinary business or for obtaining desired information.

Wiley—Another Happy Warrior

HARVEY W. WILEY will be aligned with those historical figures who appear at just the proper time to prevent a situation's going begging. What he had in common with others of his kind was a personal force amounting almost to pugnacity, coupled with a spirit of crusadership; what distinguished him from many was his absolute integrity and sincerity of purpose. At a time when food commodities were crying for chemical control, these qualities enabled him, from his post as chief of the Bureau of Chemistry, to become the champion of a cause that produced the Pure Food and Drug Act in 1906. For the first time, manufacturers had to make chemical studies on foods; and presently followed the whole scope of research that included everything from colors to tin-corrosion. It is in this light that his deeds are to be valued and respected from the technical side. And if personality can indeed be emulated, he certainly offers a granitic model of the fearless purpose that usually prevails in crises. Of course, this attitude entails a never-ending swarm of animosities; but Dr. Wiley seemed to enjoy a combat.



Building Housing the Evaporating Equipment at the Westvaco Company's South Charleston Plant



Westvaco Sets New Record in Evaporating Electrolytic Caustic Soda

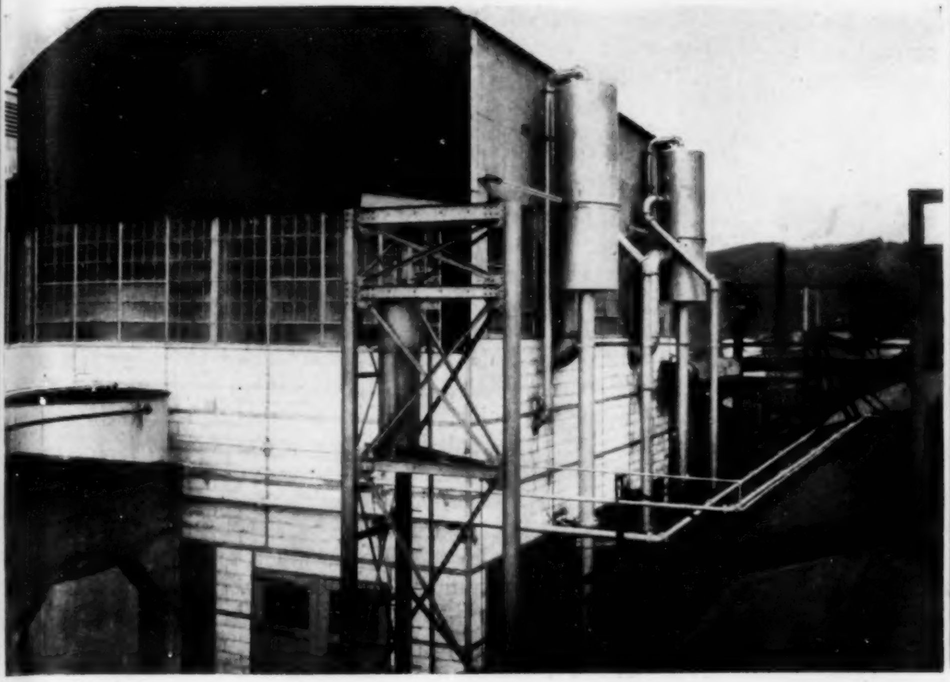
By JAMES A. LEE

Assistant Editor, Chem. & Met.

THREE YEARS AGO the Westvaco Chlorine Products, Inc., installed at its South Charleston (W. Va.) plant 2,240 Vorce chlorine cells, and eight months ago another installation was made. Many new economies were effected not only in their operation but in their installation, and they resulted in a large saving of floor space. Inspired, no doubt, by this success, the company determined to install evaporating equipment that would, with equal efficiency, concentrate the caustic and recover the salt in the weak-liquor effluent from the cells. In early November, 1929, a combination of Swenson double- and single-effect evaporators of the forced circulation type, and supplementary equipment were put in operation.

This equipment brought about what is believed to be a new efficiency record for electrolytic caustic evaporation, which includes a two weeks' average over-all caustic yield of approximately 98 per cent, an unusually small entrainment loss, and a low over-all steam consumption. This system has sufficient capacity in 24 hours to evaporate 53 tons of NaOH to a 42 per cent solution starting with cell liquor containing 7.5 per cent NaOH and 17.5 per cent NaCl, and including the wash water used in the salt separation. The capacity will also provide for concentrating 25 tons of NaOH from 42 to 50 per cent.

The chemical engineer will be interested in the economic and engineering considerations which governed the selection of the combination of a double-effect evaporator, for preliminary concentration, and a single-effect, forced circulation, vertical-tube type to complete the evaporation. Continuous operation of every step in the recovery of the salt and concentration of the caustic makes possible a saving in floor space. The high-boiling caustic solution can be efficiently evaporated by this type of evaporator, operating at low temperature drops, which means that low-pressure steam can be used in multiple-effect operation. This system operates at a high capacity per unit of heating surface. Forced circulation reduces salting of the tubes very appreciably. Entrainment losses are unusually small as a result of the scrubbing action of the liquor curtain from the deflector above the heating element combined with the upper part of the salt-settler body acting also as an entrainment separator. In addition to these considerations, the arrangement and size of evaporators were balanced



centrifugal pump. This pump contains a completely removable $3\frac{1}{2}$ per cent nickel cast-iron liner and a Monel metal impeller. The 5-ft. diameter Byer counter-current cataract barometric condensers used in conjunction with the evaporators can be seen in Fig. 4. Two Chicago Pneumatic rotative dry vacuum pumps remove the non-condensable gases from the condensers. Andale liquor preheaters of the multi-pass type and equipped with nickel tubes are used with the evaporators.

The three products, chlorine, hydrogen and a dilute solution of caustic soda, are obtained when salt brine is electrolytically dissociated in a Vorce cell. Much of the chlorine produced in the Westvaco plant is piped to a neighboring plant where it is used in the production of other chemicals. The remaining chlorine is liquefied and shipped to chemical manufacturers in other parts of the country or used in manufacturing chlorine products. The dilute solution of caustic is concentrated and purified. Some of the caustic is piped to an adjoining plant at a concentration of approximately 50 per cent or shipped as liquid in tank cars and the remainder is sold in solid form, after concentration in gas-fired pots.

The Vorce cell as operated by Westvaco does not dissociate all of the brine; the small quantity that remains undissociated passes off in the caustic solution. The

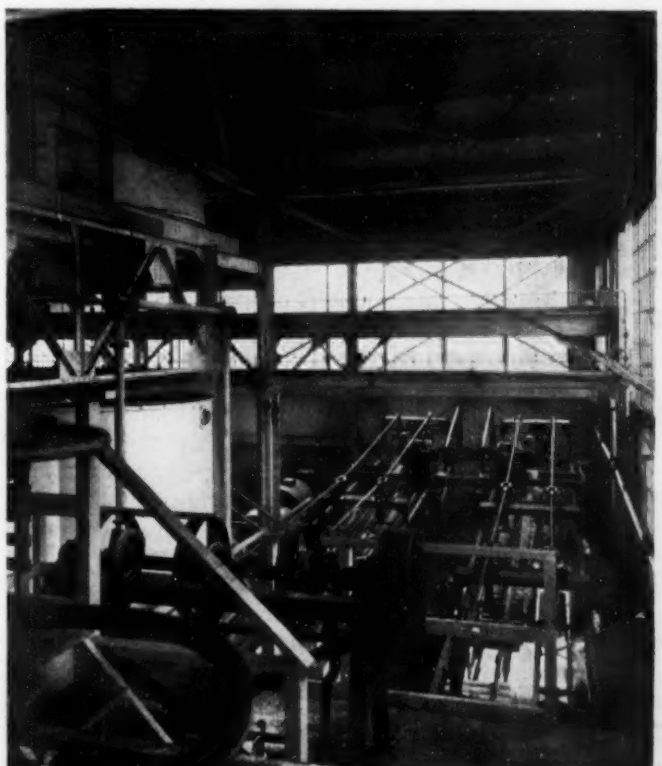
against such factors as volume of liquor to be evaporated, final concentration desired, available steam pressure, and cost of equipment and installation.

The building construction and the installation of process equipment was awarded to the H. K. Ferguson Company, which had been so successful in its initial installation of Vorce cells. Selection of this equipment followed a long discussion between engineers of the Westvaco company, the Ferguson company, and manufacturers of the particular types of machinery involved, with the end in view of eliminating the more inefficient features and operating troubles of the installation already operating. The building shown in illustration represents some of the most modern developments in chemical plant construction. The building is of structural steel framework with Ribrock hollow gypsum blocks made by the Warner Chemical Company, and corrugated galvanized steel, which latter material is used also to cover the peaked monitor roof. A series of 6-ft. windows encircle the building on the operating floor and, with stationary louvers, provide excellent lighting and ventilation. Additional lighting efficiency is obtained by the use of aluminum for interior paint.

Construction of the Swenson forced-circulation evaporators for electrolytic caustic soda may be observed in Fig. 4. The principal body of each effect is 8 ft. in diameter and 15 ft. high on the straight section. The salt settler, or secondary body, is 6 ft. in diameter and of the same height. Nickel cast iron is used for both bodies, and all tubes and sheets are nickel, thus avoiding the expense and delays of replacing iron parts that fail from caustic embrittlement. A feature of this type of evaporator is the parabolic deflector suspended above the heating element. It deflects the effluent from the tubes downward, thus forming a liquid curtain which results in a separation of the vapor and liquor. It also acts as an efficient entrainment separator, as pointed out.

Evaporating liquor is continuously circulated from the body of the evaporator up through the tubes by means of a high-efficiency 12-in. discharge Kingsford low-head

Fig. 1—The Salt Is Washed While on the Dorr Classifiers. Two Hot Wash Water Tanks Are in the Upper Left Corner and Below Are the Caustic Storage Tanks



process of recovering the salt, which is done also for the purpose of purifying the caustic soda, is carried out in the evaporator house during the process of concentrating the caustic. For a detailed description of the cells and their operation the reader is referred to an article by S. D. Kirkpatrick in *Chem. & Met.* (vol. 35, p. 158, 1928).

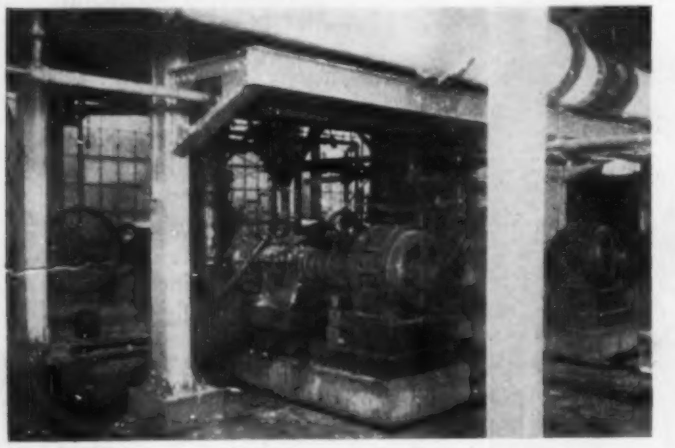


Fig. 2—Evaporating Liquor Is Continuously Circulated From the Body of the Evaporators up Through the Tubes by Means of a High-Efficiency 12-in. Discharge Kingsford Lowhead Centrifugal Pump

Dilute caustic solution drips from the cells into cups, and from them is piped to the three storage tanks near the evaporator house. This liquor is at a density of 25-27 deg. Bé. and contains in addition to 7.5-8.5 per cent sodium hydroxide, 17-18 per cent sodium chloride. The weak caustic liquor, before being sent to the first effect of the double-effect evaporator as feed, is used for washing the salt on the classifiers; to flush the salt magma from the settling tanks to the thickener; and also to flush the salt magma effluent from the 40-ton Laughlin filter to the thickener. There are two of these continuous horizontal centrifugal type filters in the installation; the larger has a capacity of removing 150 tons of salt from caustic solutions in 24 hours. In this way considerable washing action is accomplished by the feed solution requiring less water wash. As needed the solution is pumped by a centrifugal pump from the filtrate tanks preceding the above operations, to the preheater, where it is raised to the temperature of approximately 180 deg. F.

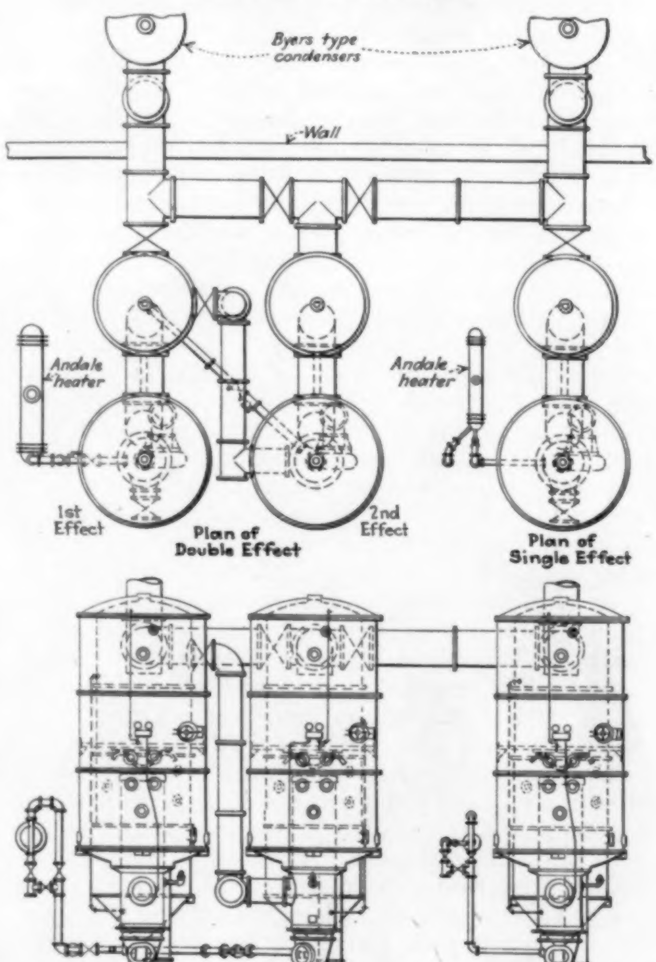
In the first effect the liquor is concentrated to 30 deg. Bé. and in the second effect to 35-37 deg. Bé. During the evaporation some of the salt crystallizes and is collected in the second body, the salt settler, adjacent to the main body of the evaporator, and from this it is pumped to the settling tanks.

From the second effect of the double-effect evaporator the liquor is pumped to a series of three cone-bottom settling tanks. Salt settles in the cone-shaped bottoms and is pumped by Dorrco duplex sludge pumps to the thickener. The clear liquor overflow is returned to the second effect, a part, however, going to the 36-deg. Bé. storage tanks. As required the liquor in the 36-deg. Bé. storage tanks is pumped through a preheater to the single-effect evaporator.

The hot concentrated 48-50 deg. Bé. solution from the single-effect evaporator, containing 50 per cent sodium hydroxide, approximately $7\frac{1}{2}$ per cent suspended solids, and 1.8 per cent salt in solution leaving the evaporator is pumped to the Swenson-Walker continuous crystallizer. It enters one end of a trough and is cooled by the counter-current flow of the cooling water in the jackets. The screw conveyor discharges the salt at the lower end of the last trough. At the time I visited the plant (April 16, 1930) three 30-ft. decks were used. However, it has been found that two additional decks will be necessary to take care of the requirements during the summer months. The normal temperature of the river water for cooling purposes in the summer months is 85 deg. F., and since the solution of salt must be cooled to 86 deg. F., the additional decks have been found to be necessary to avoid the use of an enormously greater volume of water. During the cooling approximately one-half of the salt in solution is crystallized out. It is filtered out of the solution in the smaller Laughlin filter. Falling into a cone-shaped tank below, it is diluted with cell liquor and pumped into the Dorr thickener. The 50 per cent caustic from the filter is piped to an adjoining plant, shipped as liquid in tank cars or, piped to the fusion building where it is further evaporated to solid caustic in open kettles.

The overflow from the thickener is drained to the two

Fig. 3—Combination of Swenson Double-Effect Evaporator of the Forced-Circulation Vertical-Tube Type for Preliminary Concentration and a Single-Effect to Complete the Evaporation Is Used in the Westvaco Plant



filtrate tanks and to the first effect of the evaporator. The salt which settles to the bottom of the thickener is pumped by sludge pumps to the two four-deck Dorr washing classifiers. It is first washed with cell liquor, next with the filtrate from the large Laughlin filter, and finally with hot water (condensate from the evaporators). Wash water from the classifiers flows into the wash-water receiving tank and is pumped to the thickener. The wash water containing a small quantity of caustic is withdrawn from the suction box near the salt-discharge end of the classifiers by a 15-20-in. vacuum pump, and is pumped back to the preceding deck of the classifier. As the salt leaves the classifiers it is flushed with fresh water to the larger Laughlin filter, and is then flushed out into the salt saturating and recovery tanks.

In the recovery tanks the recovered salt is used in preparing the 24-25-deg. Bé. salt solution for use in the Vorce cells. The saturated solution is pumped to the brine tanks. Water from the large filter is used for the second wash water in the classifier. The brine solution for the Vorce cells contains about 0.015 per cent sodium hydroxide, which is used with soda ash for precipitating lime and magnesia in fresh brine, any excess of alkalinity

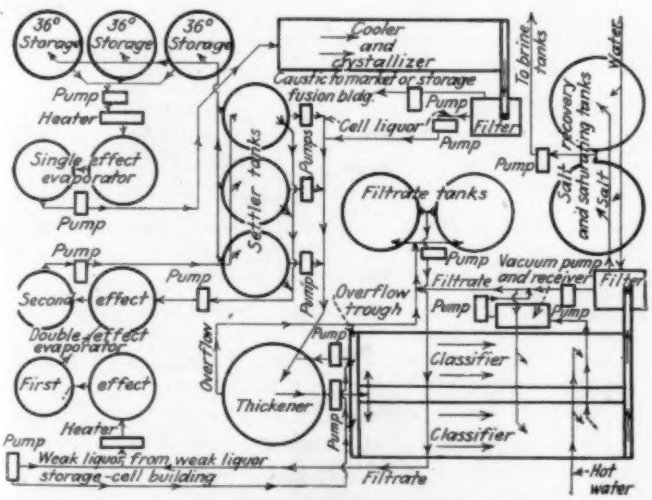


Fig. 4—Flow Sheet of Salt and Caustic Recovery Unit

being neutralized with hydrochloric acid before the brine returns to the cell.

A 24-hour test run was made on the evaporator plant beginning at 9 a.m. Dec. 13, 1929. This test was somewhat affected by the fact that one of the settler tanks was emptied for repairs on Dec. 13 and there was some difficulty in keeping up the steam pressure between 3 and 5 a.m., Dec. 14. The test run gave these results:

	Pounds
Cell liquor pumped into system	1,371,900
Containing: NaOH	114,800
NaCl	229,600
H_2O	1,027,500
Producing 50.69 per cent NaOH	114,000
The quantity of 20 per cent caustic in the cone storage tanks increased	3,800

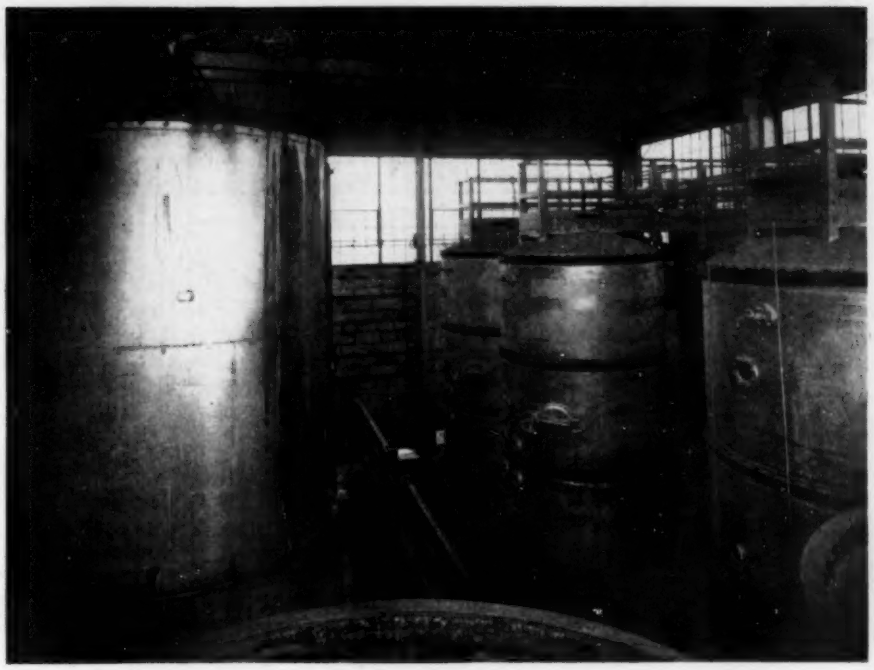


Fig. 5—Left: Salt Settler Tank. Right—The Combination of Double and Single Effect Evaporators

One of the settler tanks, as previously mentioned, was emptied into the filtrate tanks. These tanks at the end of the run contained approximately 8,750 lb. (81,000 lb. @ 10.8 per cent) more NaOH than at the start of the run, but the settler tank which was pumped into the system added 12,600 lb. NaOH (65,000 lb. @ 19.3 per cent), or a net change in the system of 3,850 lb. NaOH, which added to that pumped into the system as cell liquor, gives 59.3 tons. This checks with the quantity produced by the single-effect plus the increase in 20 per cent caustic in the cone-storage tanks calculated as follows:

		Pounds
NaOH in cell liquor		114,800
NaOH from settler		12,600
Total entering system		127,400
Less amount retained in filtrate tanks		8,750
		118,650
Less losses		1,500
Amount passing through double effect		117,150
Total NaOH entering system		127,400
Less amount retained and amount from settler tank		21,350
Amount NaOH evaporated from cell liquor		106,050
Cell liquor actually evaporated		1,277,900
106,000 lb. NaOH ÷ 19.3 per cent or amount leaving the double effect		550,000
NaCl = 550,000 × 10.04 per cent	55,220 lb.	
NaOH = 550,000 × 19.3 per cent	106,000 lb.	
Total NaCl + NaOH		161,220
H_2O		388,780
Water in cell liquor		957,000
Water in 19.3 per cent NaOH		388,780
Water evaporated from cell liquor by double effect		568,220
Wash Water		171,000
Total water evaporated by double effect		739,220

It is apparent that the double-effect evaporator produced approximately 53 tons of 100 per cent caustic from cell liquor at approximately 9 per cent NaOH, evaporating 739,220 lb. of water.

The 50.69 per cent caustic solution from the single-

effect, containing 106,000 lb. NaOH weighed $\frac{106,000}{0.5069} =$ 210,000 lb. and contained

106,000 lb.	NaOH
2,390 lb.	NaCl (1.14%)
108,390 lb.	total solids
101,610 lb.	water
210,000 lb.	

On this basis total evaporation for 106,000 lb. NaOH produced:

	Pounds
Water in cell liquor	957,000
Water in strong caustic	102,000
Total evaporation from cell liquor	855,000
Wash water	171,000
Total evaporation for 53 tons	1,026,000

Evaporation in the single-effect produces 53 tons of 19.3 per cent caustic or a total solution of 550,000 lb. of the following analysis: 19.3 per cent NaOH; 10.04 per cent NaCl and 70.66 per cent H_2O was evaporated to a solution showing an analysis of 50.69 per cent NaOH, 1.14 per cent NaCl and 48.17 per cent H_2O. The evaporation in the single-effect, therefore, is as follows: Quantity of water entering the single-effect in solution, 388,000 lb.; quantity of water leaving the single-effect in solution, 102,000 lb.; evaporation in single-effect, 286,000 lb.; evaporation in double-effect, 739,200 lb.; and total evaporation of 1,025,200 lb.

The condensed steam for the 24 hours was 746,000 lb. This was at 10 lb. gage pressure.

A number of entrainment tests were made on the installation by determining the per cent caustic in the water vapor passing in each pipe and the official results indicated an over-all caustic yield for the entire plant of 98.7 per cent.

An average of 2,200 gal. of cooling water per minute was used in the condensers. The power consumption of the pumps used for circulating the liquor in the evaporators was 90 kw. per hour, or 40 hp. for each pump.

Westvaco and the engineers responsible for the selection of the equipment are to be complimented upon the gratifying results of this test run, which should serve to inspire others to similar economic and operating efficiencies.

▼ ▼ ▼

Demand Continues for Reclaimed Rubber

IN THE June, 1930, report of the U. S. Department of Commerce, Harry W. Newman, of the rubber division, gives some interesting facts concerning reclaimed rubber. He states that it has become an essential element in the manufacture of rubber goods. Nothing proves this statement more forcefully than the fact that, despite falling prices of crude rubber within the past two years, the use of reclaimed rubber has been maintained at practically the same level. Ten years ago reclaimed rubber, although known to rubber chemists over a long period, was still more or less in its experimental stage. If it were not, it was certainly considered a low-price substance. Now it is as much a raw material to the industry as latex, sulphur, carbon black, and the like.

The present position of reclaimed rubber in the industry is best indicated perhaps by the fact that of the total amount of crude and reclaimed rubber consumed in the United States during 1928, the reclaimed product consisted of 50.4 per cent. In 1929 it was back to the 1927 level, or 47.9 per cent. Other facts to prove the status of reclaimed rubber are increased production and exportation. Production in the United States advanced from 208,516 long tons in 1928 to 219,057 in 1929, while exports increased from 9,577 to 12,721 tons.

Every principal rubber manufacturing country has at least one plant for the reclamation of rubber within its domain. The latest country to establish a factory seems to be Soviet Russia. At the beginning of 1930 the Soviet Government negotiated plans for a reclaiming plant to be patterned after a well known independent factory in the United States. It expects to be functioning before the close of the year.

The United States is not the only country which is increasing the production and exports of reclaimed rubber. The United Kingdom, France, Italy, the Netherlands, are all strengthening their exports. Germany, the one exception, showed a decline in exports during 1929, but this was due to the closing down of the principal reclaimed factory in that country. Exports necessarily decreased but imports advanced more than 100 per cent.

The following table shows the exports in pounds of reclaimed rubber from countries which separately enumerate them in their official trade statistics.

Country	1926	1927	1928	1929
United States	12,075,640	19,130,429	22,452,956	27,707,161
United Kingdom	4,582,500	5,680,900	4,768,100	*5,038,400
Germany†	3,879,040	1,958,254	3,071,054	1,335,183
Italy	236,710	1,098,694	297,675	430,857
Netherlands	6,065	130	2,204	143,260
Sweden‡	6,453	17,632	31,411	(§)
Poland	....	3,306	3,306	(§)

*Estimated.

†Contains some soft rubber paste, but mostly reclaimed.

‡Includes crude rubber if any.

§Not available.

Exports of reclaimed rubber from the United States in 1929 advanced by 23 per cent, as compared with 1928. The increasing use of reclaimed rubber in another angle is also shown by the activities of the United States in the foreign field. In 1928 we shipped reclaimed rubber to 17 markets and in 1929 we had extended our trade to 26 countries. Even such minor producing countries as Newfoundland, Greece, Venezuela, British India, and the Philippines imported small quantities of the reclaimed product from the United States.

Back of the reclaimed-rubber industry stands the trade in scrap and old rubber, which is increasing each year. As the consumption of reclaimed rubber becomes more expansive, the demand for rubber waste and débris will naturally increase. Consequently, the increased popularity of reclaimed rubber is reflected to a certain extent in the increasing trade of scrap rubber.

A considerable quantity of old rubber exported does not find its way to the reclaimer. Many unique uses have been found for old rubber goods. Old tires are made into shoes, rubber soles and heels, while inner tubes are cut into rubber bands and many other objects.

How the Chemical Product Differs Economically

By LAWRENCE W. BASS

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Bachrach

Prior to his advent at Mellon Institute in 1929, Dr. Bass had been with the Rockefeller Institute's chemistry division for four years. His broad education was gained at the Universities of Tulane, Yale, Lille and Paris, at Pasteur Institute, and as National Research Fellow in 1922-23

SCIENTIFIC MANAGEMENT is availing itself to an ever-increasing extent of the results of dependable statistical surveys of the industries. But at present the technique of using such materials to replace the approximate estimates or cruder guesses of previous years is in a formative stage. It seems probable that new methods will be evolved from time to time as aids to obtaining correct conceptions of various factors of production and consumption.

The ratio of wages to value added by manufacture is one apparently useful procedure for expressing an important production factor—namely, the productivity of labor—in any specific industry. It is, moreover, relatively simple, for the data are in general readily available and the computations are certainly not difficult. This method, however, does not appear to have attracted much attention. The more usual practices have been to measure productivity in terms of physical output or of total value of product. The ratio discussed in this paper possesses for many purposes an advantage over the former in that it permits to some degree a comparison between industries manufacturing different types of products, and over the latter in that one factor variable among industries—namely, material costs—is eliminated by considering the relation between wages and the sum of overheads and profit.

It is pertinent to mention here the searching study by Alford and Hannum (*Mech. Eng.*, **51**, 181, 1929), which led to the formulation of the kilo man-hour as a basis for evaluating manufacturing operation. These authors undoubtedly have developed a method that will be of importance as a precise instrument of management. The ratio of wages to value added by manufacture is in a sense a modification of this method, for payroll totals are a function of man-hours, taking into account also the skill of the workers and the conditions of employment in the industry.

RESULTS of a computation for major groups of industries of the ratio of wages to value added by manufacture, or, more briefly, added value, are presented in Table I. The most striking fact revealed by these data is the characteristic low ratio in the chemical industries. It is, of course, impossible to differentiate sharply between chemical and non-chemical manufacturing, because chemistry plays a greater or less part in every industry; indeed, even in those branches of manufacture classed as chemical in the "Census of Manufactures," whose classification scheme has been followed in the tabulation, the complexity of the chemical changes varies greatly. It appears evident, nevertheless, that, in general, those industries in which "chemical" transformations predominate—as opposed to "physical" changes, in which there occur no deep-seated alterations in the composition of the materials—are characterized as a group by the much higher value added by manufacture in proportion to labor costs. It is interesting to note also that, according to Alford and Hannum, the value of product per kilo man-hour is very high in the case of many chemical manufactures.

The wages-added value ratio is not to be taken in any sense as a direct measure of profit. The overheads, representing a value comparable in magnitude to prime costs, vary greatly in the major industrial groups and in the individual industries. If, in a given industry, one cost component is low, other factors usually tend to counteract this effect. For example, as De Long (*Chem. & Met.*, **32**, 919, 1925), has pointed out, the ratios of wages and material costs to total value of products are roughly in inverse proportion to each other. Then, again, the same author (*Chem. & Met.*, **32**, 853, 1925) has shown that the capital ratio exhibits considerable variation in different types of manufactures; in the chemical industries, for instance, it is comparatively high.

The major groups of industries listed in Table I are made up of widely varying minor branches of manufacture. This diversity renders generalizations of doubtful value until more exhaustive analyses are avail-

able. It is relevant to this discussion, however, to mention that there is no obvious simple explanation of the characteristic low ratio of wages to added value in the chemical industries. Other related aspects that have been considered in the possibility that they might throw light on this situation are the following: wages-material costs; added value-material costs; average wage rates; salaries-wages; salaries plus wages-added value. In addition, the components of the major groups of industries have been itemized. The data used for all computations were obtained from the governmental censuses of manufactures for the respective years. In all tables the groups of industries and separate industries are listed according to order of importance of total value of products.

Considering first the figures given in Table I, it is noteworthy that the ratio of wages to value added by manufacture shows a striking regularity for most of the groups, especially in view of the fact that data for pre-war and post-war years are being compared. Throughout the period analyzed, the chemical industries have a very low ratio, being second in this respect only to tobacco manufactures, which, incidentally, constitutes the least important group listed, from the standpoint of total value of products. A further qualifying consideration in respect to tobacco manufactures lies in the fact that the very low wages (and wages plus salaries, Table II) to added value ratio is largely due to the increase in overhead represented by the inclusion of internal-revenue taxes in the total value of products, and, consequently, in the value added by manufacture. It should be noted also that railroad repair shops constitute an exceptional case, because the values of products represent, in general, only the sum of the costs of materials and salaries and wages; in some cases other expense factors were included.

Table I—Ratios of Wages to Added Value—Major Groups of Manufacturing Industries

(In Per Cent)

	1914	1923	1925	1927
All industries	42	43	40	39
Foods	29	32	30	28
Textiles	47	43	44	44
Chemicals	23	25	23	23
Iron and steel	51	50	47	48
Machinery	45	44	40	39
Transportation equipment	46	50	44	45
Paper, printing, etc.	34	33	32	31
Lumber, etc.	53	49	50	51
Nonferrous metals	42	45	43	43
Leather	48	49	47	47
Stone and ceramic products	55	46	45	46
Railroad repair shops	87	87	87	87
Rubber	32	40	35	35
Tobacco	28	23	17	14

A similar study, of which the details have been omitted, was made for the ratio of wages to material costs. The average for all industries in 1927 was 31 per cent. Chemicals, with a ratio of 13 per cent, were next to the lowest in the list, foods with 10 per cent. These ratios also showed similar constancy throughout the period 1914-1927.

It appeared possible that the low wages to added value ratio in chemicals might be related to an abnormally high added value in comparison with material costs. Investigation of this point, however, showed that these industries, with a ratio of 58 per cent in 1927, were even lower than the average for all industries, 79 per cent. The range in the groups was from foods, 36 per cent, to stone and ceramic products, 171 per cent, and tobacco manufactures, 176 per cent. Here again little change was shown in any group from the pre-war years to 1927.

Table II—Ratios of Wages Plus Salaries to Added Value—Major Groups of Manufacturing Industries, 1925

(In Per Cent)

	Salaries / Wages	Wages / Added Value	Wages Plus Salaries / Added Value
All industries	27	40	51
Foods	33	30	39
Textiles	20	44	53
Chemicals	47	23	33
Iron and steel	21	47	57
Machinery	33	40	54
Transportation equipment	18	44	52
Paper, printing, etc.	56	32	50
Lumber, etc.	20	50	60
Nonferrous metals	27	43	55
Leather	21	47	58
Stone and ceramic products	21	45	54
Railroad repair shops	14	87	99
Rubber	26	35	45
Tobacco	20	17	20

Wage rates in the chemical industries are close to the average for all industries (see also Tyler's "Chemical Engineering Economics," pp. 41-48, 1926); therefore the explanation of the low wages-added value ratio cannot lie in a low payment of workers. The census statistics are not adaptable for use in computing an average wage, but a rough estimation bears this out.

It has frequently been mentioned that the ratio of salaries in the chemical industries is abnormally high, and indeed it is evident from the analysis of the data for 1925 in Table II that this assertion is true. The higher proportion of salaries, however, does not suffice to bring the ratio of wages plus salaries to added value to a high percentage in comparison with other industries. This major group is again well below the average for all industries and is second only to tobacco manufacture, which, as indicated above, represents a special case.

Table III—Ratios of Wages to Added Value for Chemical Industries

(In Per Cent)

	1914	1923	1927
Petroleum refining	27	28	29
Chemicals, not elsewhere classified	32	32	29
Paints and varnishes	18	19	19
Manufactured gas	19	23	22
Coke	47	30	36
Soap	21	20	17
Patent medicines and compounds	10	11	9
Cottonseed oil and cake	27	27	25
Fertilizers	23	30	34
Perfumery and cosmetics	14	11	10
Linseed oil, cake, and meal	21	36	31
Druggists' preparations	19	20	17
Oils, not elsewhere classified	12	16	16
Baking powder and yeasts	11	16	8
Explosives	28	26	23
Greases	45	40	35
Cleaning and polishing preparations	12	13	12
Printing ink	15	20	17
Dyestuffs and tanning materials	22	32	24
Salt	39	40	36
Glue and gelatin	42	42	38
Wood distillation	46	35	39
Sulfuric, nitric, and mixed acids	26	27	26
Blackings, stains, and dressings	18	14	16
Bone black, carbon black, and lampblack	30	16	27
Drug grinding	20	22	23
Candles	30	28	22
Writing ink	17	18	18
Essential oils	18	26	21
Bluing	15	22	15

The low ratio of wages to added value obtains throughout the industries in the chemical group, as shown in Table III. This point is worthy of note, lest it be thought that a few very low ratios might decrease considerably an otherwise average value. This detailed analysis reveals that, although the percentages in some of the separate industries are remarkably small, even the highest are not far from the average for all industries. In a similar manner, values are given in Table IV

for the more important component manufactures of the major groups listed in Table I.

From a broad consideration of all the data presented in this paper, the conclusion seems to be warranted that in the period 1914-1927 the ratio of wages to added value has remained nearly constant, though there is evidence for the belief that the increased efficiency of manufacturing operations is reflected in a slight decrease in the ratio in the more recent years. This general conclusion is apparent in the data for all industries, in the major groups of manufactures, and in the individual industries. This, then, may be taken as the normal course of manufacturing for the period.

There are a few marked exceptions to the rule, and in some cases they may be explained on the basis of profound changes in the character of the industry concerned. The ratio of wages to added value in coke manufacture dropped from 47, in 1914, to 30, in 1923. This decrease represents the effect of the main transition from beehive ovens to byproduct practice; the two processes are widely different in their wage-added value ratios, 43 and 26, respectively, according to the data for 1923. In 1914, 57 per cent of the total coke was produced in beehive ovens, while in 1923 only 22 per cent was thus made. Glass manufacture presents still another example of marked decrease in the wage factor, the ratios in 1914 and 1923 being 63 and 46 per cent, respectively. This drop has resulted, of course, from increased mechanization in the industry.

Table IV—Ratios of Wages to Added Value for Important Branches of Manufacturing

(In Per Cent)

	1914	1923	1927
Foods			
Slaughtering and meat packing	30	41	41
Bakery products	35	39	34
Flour and grain mills	20	26	21
Butter	33	27	25
Sugar refining (cane)	31	45	39
Canning and preserving	32	26	29
Beverages	28	29	25
Condensed milk	27	31	23
Textiles			
Clothing	40	35	35
Cotton goods	60	53	55
Woolen manufactures	56	50	53
Knit goods	53	46	48
Silk manufactures	43	45	46
Iron and steel			
Steel works and rolling mills	57	57	55
Structural iron and steelwork	47	45	43
Tools and cutlery	48	42	40
Steam fittings, etc.	45	47	44
Blast furnaces	43	33	34
Hardware	51	47	45
Stoves and furnaces	47	45	39
Machinery			
Foundries and machine shops	48	46	43
Electrical machinery	41	41	34
Engines and water wheels	59	50	42
Agricultural implements	38	46	40
Transportation equipment			
Motor vehicles	32	40	34
Motor vehicle bodies and parts	53	56	57
Cars, steam and electric railroad	66	68	59
Shipbuilding	66	70	66
Locomotives	56	57	57
Paper, printing, etc.			
Printing and publishing	30	29	26
Paper and wood pulp	45	45	39
Lumber, etc.			
Lumber and timber products	55	52	57
Furniture	50	47	48
Planing-mill products	50	46	48
Non-ferrous metals			
Copper	25	36	25
Brass, bronze, etc	54	49	48
Lead	35	43	35
Aluminum	50	49	48
Leather			
Boots and shoes	55	53	50
Leather, tanned	38	44	42
Stone and ceramic products			
Clay products	59	54	55
Cement	37	30	31
Glass	63	46	47
Stone	55	49	51
Pottery, porcelain	67	58	59
Rubber			
Tires and inner tubes	..	39	32
Rubber goods, not elsewhere classified	32	43	41
Boots and shoes	33	39	39

A few cases are found also in which the ratio of wages to added value has increased. Two examples are meat products (slaughtering and meat packing) and cane sugar refining, with changes from 30 to 41 and from 31 to 45, respectively, between 1914 and 1923. These two industries have already been analyzed in detail by Alford (in "Recent Economic Changes in the United States," 1929, pp. 147-166), who shows that they fall in the group of manufactures that may be characterized as "not well-favored," or, in other words, that their percentage increases in productivity per man-hour have not been of favorable magnitude during this period.

In conclusion, it is demonstrated by these facts that in the chemical industries wages and salaries are a minor cost component in comparison with other industries in regard to the value added to raw materials by the processes of manufacture. A similar relationship exists in this group between wages and material costs. The opportunity for effecting further savings in cost of manufacture in this particular field therefore appears to lie in decreasing the overheads or in employing cheaper raw materials.

In the report by Alford and Hannum already referred to, these authors emphasize the fact that but little significance should be attached to their numerical values; the important features are the relationships and relative positions in sequence. A similar caution is requested in considering the contents of the present paper. It is thought, however, that more studies of this type will so reveal the value of statistical investigations that data will become available for the formulation of definite recommendations that will be of real utility in management.

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Effect of Chlorine in Fertilizer

It has been demonstrated that on some soils fertilizers supplying moderate quantities of chlorine produce an appreciable increase in yield of tobacco, according to the Annual Report, Bureau of Plant Industry. The size of the leaf is increased, and other elements of quality are improved. On the other hand, the use of too much chlorine is decidedly injurious to growth, resulting in an abnormally thickened leaf; and after curing, the product possesses undesirable colors, unsatisfactory combustibility, and poor keeping qualities.

Physiological studies have shown that chlorides have a marked effect in increasing the water content of the leaf and may be quite effective in preventing injury from the so-called "drought spot," which is essentially a localized drying out of the leaf tissues. Moreover, the increasing water content resulting from the presence of chlorides in the tissues may profoundly affect carbohydrate metabolism. A high content of chlorides thus tends to paralyze the enzymatic processes involved in transformation of starch into sugar, thereby impairing the nutrition of the plant. By properly controlling the chlorine content of the fertilizer it is possible to secure its beneficial effects and at the same time avoid the injurious action on the nutrition of the plant and the quality of the cured leaf.

Fig. 1—Vertical Welder in Action; Note Size in Comparison With Men on Control Platforms

Fabricating PRESSURE VESSELS With Forge Welding

Roll and Hammer Processes at American Welding Company

By THEODORE R. OLIVE

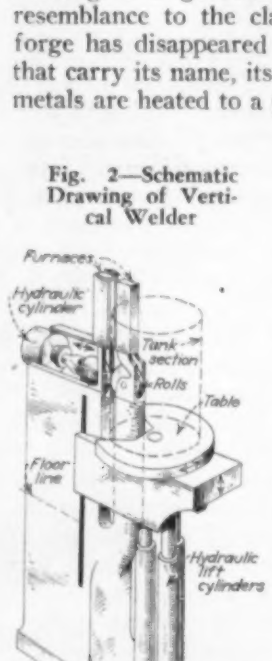
Assistant Editor, Chem. & Met.

WELDING is not only the oldest known way of permanently joining metals but it probably is the method most commonly used today. Particularly in chemical equipment it is found to be nearly ideal for most purposes, in one or another of its types.

Welding processes fall into two principal classes, distinguished both by method of accomplishment and by the temperature at which the operation is carried out. Fusion processes, typified by thermit, gas, and electric arc methods, are performed at temperatures in excess of 4,000 deg. F., and produce a deposit of metal somewhat of the nature of a casting which fuses to and joins the pieces of metal being welded. The other principal division, forge methods, operates in the case of steel at 2,600 to 2,800 deg. F. when the metal is just sticky.

This second classification, forge welding, presents its simplest form in the work of the blacksmith. But forge welding is a generic term and most types bear little resemblance to the classical method. Yet, though the forge has disappeared in some of the modern processes that carry its name, its function remains. Whenever the metals are heated to a point of incipient fusion, and then welded into one continuous whole by great pressure or by the force of many blows, we have forge welding. Even the electrical resistance methods known as spot and percussive welding are cases in point. Other processes employ the pneumatic hammer, as in hammer welding (described by E. E. Thum in articles on the Blaw-Knox and National Tube Company plants in *Chem. & Met.*, **25**, 1921, pp. 553, 747, 921). Or the pieces may be rolled together under high hydraulic pressure while at the welding temperature.

Fig. 2—Schematic Drawing of Vertical Welder



Roll welding has an interesting history. It was an earlier member of the family responsible for its development, who built the "Monitor" of Civil War fame. The old Continental Iron Works in Brooklyn was the scene of that history-making development, as it was 20 years later the scene of the birth of roll welding. During the 80's Thomas Fitch Rowland, proprietor of the Continental Iron Works, evolved the idea of roll welding from something he had seen in Europe and, returning to the Iron Works, painstakingly developed it to a practical method. For this he had to design and build the necessary machinery, as at that time there was no precedent for such equipment. Then during the middle 90's, a nephew of his, Charles L. Rowland, left the Iron Works and went to Carbondale, Pa., where he established the American Welding Company. Here he too continued the development of the idea.

When, a few years ago, the American Car & Foundry Company purchased the American Welding Company, and a little later the Iron Works discontinued business, much of the special machinery of the latter concern was purchased and transferred to the Carbondale plant. The

Fig. 3—Tank Sections up to 96-In. Diameter and 16 Ft. Long Can Be Annealed in This Furnace; Note Cover Swung Away for Loading

present company is engaged principally in the making of three classes of equipment: car and storage tanks; 1-ton containers for compressed gases, of which this concern is the only producer; and corrugated Morison furnaces used in Scotch boilers.

A hasty trip through the plant, where we can observe the making of a car tank, and then of a 1-ton container, will acquaint us with both roll welding and the hammer welding that must necessarily go with it. Before we turn to either, however, a few general points should be mentioned. To weld metal it must be heated. Long experience has established water gas as the fuel for forge welding, and it is, in fact, the only fuel recognized for the purpose by the Bureau of Explosives. The plant

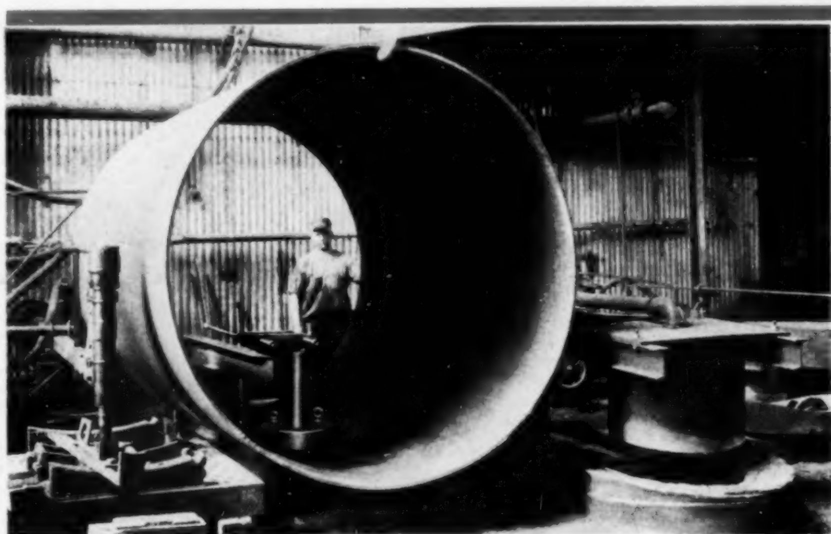


Fig. 4—Flue Hole for Manhole Connection Being Pulled in Tank Center Section; Plug Has Just Been Pulled Down Into Die; Furnace at Right

possesses three blue-gas generators, capable of turning out more than 420,000 cu.ft. of 342-B.t.u. gas per 14-hour day. A water scrubber and two holders of 30,000 cu.ft. total capacity clean and store the gas ready for use.

There also are other heating requirements. Finished seams must be annealed; flanges and flares must be formed; and necks pushed through plates for nozzle connections. For these operations oil-fired furnaces are used, to which the oil is pumped at 100 deg. F. and a pressure of 60 lb.

A third group of services is that supplying motive power to the welding and forming machinery. A large Southwark duplex hydraulic pump, driven by a 250-hp. motor, maintains hydraulic pressure of 1,200 lb. per square inch in an accumulator, while two steam-driven compressors furnish 100 lb. air for the hammers. There is a steam plant for the water-gas set and the compressors, and direct-current equipment to make power for incidental electric-arc welding.

This background brings us to the roll shop where a car tank of $\frac{3}{4}$-in. plate, 85 in. inside diameter and 36 ft. long, without the heads, is in process. It is to be made of open-hearth still-bottom-grade steel of 0.16 carbon content. Forge welding, we find, is best adapted to the carbon range, 0.12 to 0.16. The tank is to be made from three plates and two heads which are substantially semi-elliptical, and is to have one manhole.

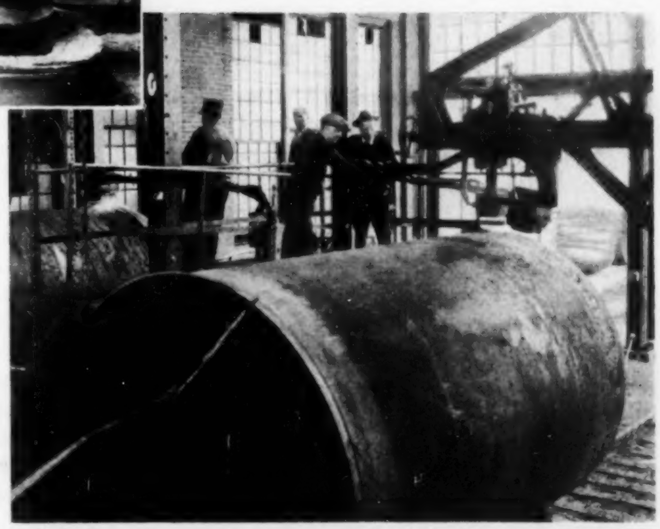
Take first one of the end plates. The initial operation is the rolling, which is performed cold, so as to bring the plate into cylindrical shape with an overlap of about 1 in. This operation is carried out on a triple roll capable of cold-bending 1-in. plate up to 16 ft. wide and $1\frac{3}{8}$-in. plates up to 12 ft. wide. The plate is passed back and forth until cylindrical form is reached.

An arc welder follows the rolling operation, tacking the overlap at two or three points and welding "ears" of $\frac{3}{4}$-in. plate to each end of the cylinder at the lap, so that the welding rolls will not reduce the metal thickness below $\frac{3}{4}$ in. at the ends. This completed, the cylinder is picked up by a crane and transferred to the roll welder.

This welder is perhaps the most interesting application of the Rowland process. It appears in Fig. 1 and is shown schematically in Fig. 2. Imagine a two-pronged fork, about 12 ft. high, and attached at the top of each prong a gas-fired furnace of firebrick, 4 ft. high and about 1 ft. wide. These project their flames toward each other. Below the furnaces are two rolls, supported one on each prong of the fork. One roll is fixed while the other is moved toward the first by a hydraulic cylinder, capable of exerting a force of 39,000 lb.

It is necessary to bring the work to the

Fig. 5 — Hammer-Welding Head Seam; Welder Is Operating Pneumatic Hammer; Note Furnace Heating Tank at Left



furnaces and rolls, and support it in any position desired. To accomplish this a table about 10 ft. in diameter is mounted on the end of a hydraulic lift, so that the fork described above extends through a notch in one side of the table. Dogs secured in grooves in the table center the work and clamp it in a suitable position. Now the cylinder is lowered into place between the prongs of the fork and aligned so that the overlap is between the furnaces and the rolls.

Then lifting the table so that the lower 4 ft. of the overlap is between the furnaces, the welder, on his elevated platform, starts his flame and adjusts it to neutrality, or so as to be very slightly reducing. He quickly raises the metal to the welding temperature of 2,700 deg. F. which he accurately judges by eye and checks occasionally with an optical pyrometer. Now he lowers the table and brings the rolls to bear, gently at first and then with full hydraulic pressure, upon the

Fig. 6—Heading-In Flue Through Which Anvil Boom Extends for Final Girth Seam; This Is the Last Welding Operation on a Car Tank; Note Pneumatic Anvil

overlap. Moving the cylinder up and down rapidly between the rolls, he "irons-out" the overlap until it has been reduced to the thickness of a single plate. During this process, to preserve the proper curvature of the weld, he also rotates the table back and forth through a small angle. A second heating and rolling usually completes the job and he has finished 4 ft. of seam in about eight minutes total elapsed time; whereupon he lowers the work, and repeats the cycle until the seam is welded.

This accomplished, and with the ears cut off, the cylinder is placed in a vertical, oil-fired annealing chamber, shown in Fig. 3, and raised to a temperature of 1,000-1,200 deg. After 18-20 minutes at the temperature, the cylinder is removed, re-rolled to insure roundness, and then set aside to cool for two or three hours before further work is done on it.

We have witnessed the welding of an end section of our tank. The middle section is a somewhat different problem, since it must be reinforced at the point where the manhole will be attached. For this purpose a special reinforcing plate takes the place of about one-quarter of the periphery of the cylinder. This plate is rolled separately to the proper radius and welded into the cylinder, using two seams. Except for a strip around the edges 7 in. wide on the sides and 9 in. wide on the ends, the plate is twice the tank thickness, while the edge strips are reduced by machining to a thickness equal to the tank, to provide for the welding. Once the two seams have been welded in a manner exactly similar to that described above, the cylinder is annealed, rerolled, and then taken to the next operation, which is known as "pulling a flue"—i.e., producing a neck in the center of the reinforced section to which the manhole nozzle is later welded.

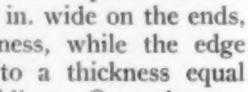


Fig. 7—Girth-Seam Annealing Furnace in Open Position

At the center of the reinforced side a 6-in. hole is first cut with an acetylene torch. Then the cylinder is laid on a small oil-fired furnace shown at the right of Fig. 4, and heated around the hole to about 2,200 deg. Meanwhile, the hydraulic puller (Fig. 4) is made ready. This machine is principally below the floor level with only a heavy pull rod extending above the surface through a collar-shaped die. A plug which is to be pulled through the tank side is supported above the die on the end of a horizontal boom. When pulling temperature is reached, the tank is quickly moved from the furnace to the die, and the pull rod is pushed up through the hole and the plug which is inside. A moment suffices to drop the plug on to the pull rod and pin it in place. Then as the press exerts a pull of 250 tons, the plug forces the metal down into the die, producing a "flue," or neck, of the desired radius and diameter. To this flue a forged steel nozzle is later welded by a special adaptation of the roll-welding process.

All roll welding has now been completed. It remains to join the three cylindrical sections and attach the heads, operations for which hammer welding is necessary. Before this is done, however, one end of each end section must be flared so that it may be lapped over the center part. Sections are taken to another shop where the end of each is heated with an annular firebrick furnace and the section transferred to the flaring machine in which two specially shaped rolls spin out a few inches of the metal to the desired flare. Heads, it might be remarked, are purchased already shaped to elliptical cross-section and properly flared.

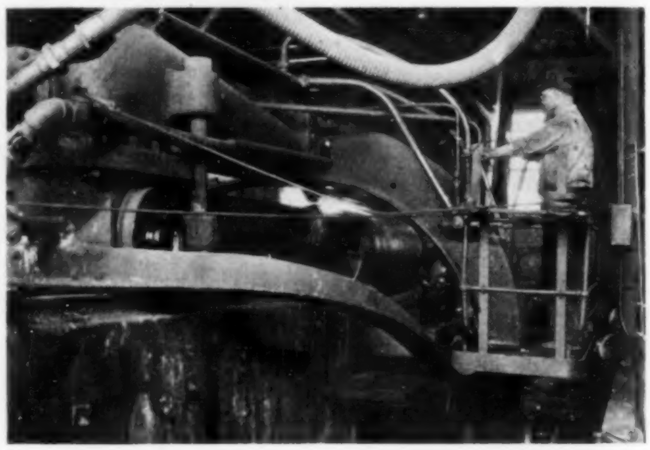


Fig. 8—Horizontal Welder Heating 1-Ton Container Preparatory to Welding; Note Upper Welding Roll at Left of Furnace; Lower Roll and Furnace Supported on Horn Inside Tank

Our tank is now ready to be assembled. The sections are carried into the hammer shop, which contains eight tracks and seven hammer-welding stations. The eighth track is for finishing operations. Tank sections are placed upon motor-driven carriages capable either of rotating the section or moving it along the track. Here the heads are lapped over the end sections and tacked at intervals by the arc welder, and the center section is tacked to one end section. This makes it possible to weld the two head seams and one center seam while working through an open end.

Tacking finished, the sections are taken to the welding stations, where heating is the first operation. Two small gas-fired furnaces suspended on the ends of long booms are brought into place to heat about 8 in. of the seam, one furnace inside and the other outside the tank, as in Fig. 5. At welding temperature, the furnaces are moved aside and the hammer and anvil moved into place. The former is pneumatically driven, supported on a boom and controlled by the welder, who stands on a platform beside the tank. It is capable of delivering blows of about 1,900 lb., at the rate of 250 per minute. The anvil is shaped to correspond to the tank curvature and is supported under the seam, also on the end of a boom.

When it is in place, an air piston in the bottom of the anvil pushes against the tank bottom and forces the anvil into contact with the seam. Quick action on the part of the welding crew then permits the joining of a few inches of seam. Heating and hammering must be repeated several times at each point, so that the entire operation on one girth seam requires eight to ten hours.

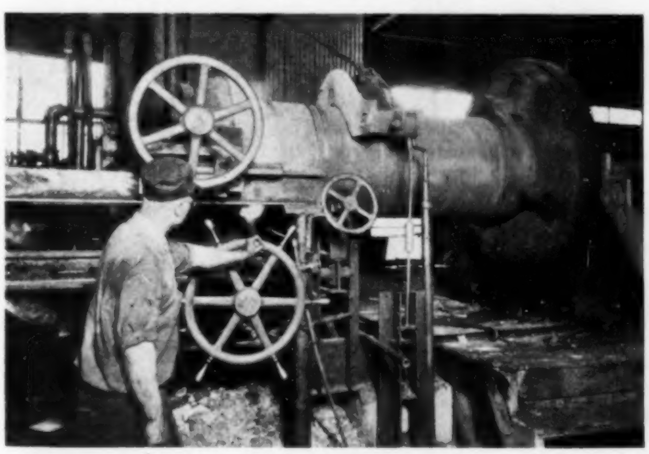
The head seams and one center seam are fairly easily welded. The final weld, however, is not quite so simple. In order to make it, a flue, similar to that for the manhole, has been pulled at the time of its manufacture, in one of the heads. This is large enough to admit the anvil, which folds back against its boom, as well as the inside furnace. Once these are in position, the welding proceeds as described above, but the operation on this final seam requires 14-18 hours, because of the difficulty in maneuvering the tools, and since upon the accuracy of this seam largely depends the straightness of the tank.

When the last seam is finished and the anvil withdrawn, the head flue must be headed in. The completed tank is carried to the finishing track, where a small dished cap is placed in the flue and the edges are heated by means of an annular, gas-fired furnace. Then with the assistance of an air-operated anvil, the three smiths, who appear in Fig. 6, weld the cap into place. This operation takes about four hours.

Meanwhile, all the welds are being carefully examined for any slight imperfections, which are immediately repaired. This completed, the tank is rolled outside and each girth seam in turn is surrounded by a split, ring-shaped, oil-fired furnace, which is sketched in Fig. 7. This brings the metal adjacent to the weld to annealing temperature. Finally the tank is put under test, first using air pressure at 100 lb. with soapsuds applied to all seams. Then it is filled with water at 500-lb. pressure and all seams are hammered with a 10-lb. sledge. Assuming that it passes the test, the tank is dried, painted, and finally delivered to its purchaser.

Manufacture of 1-ton containers, carried out in a separate shop, is similar in certain respects to the making of car tanks, but is much more rapid and more completely mechanized; witness the fact that plant capacity on this equipment is 40-50 per week as compared with 4-6 car or storage tanks. These tanks are made under I.C.C. specification 106 - A - 500 and are inspected at every step by a representative of the Bureau of Explosives. Standard dimensions call for an outside diameter of 30 in., an over-all finished length of 81 in., sides of $\frac{13}{32}$-in. plate, and crimped and welded heads of $\frac{3}{4}$-in. stock. The rolling and tacking operations are similar to those on the large tanks except that ears, tacked to the shell ends, are unnecessary. Welding of the side seam is similar in principle, although it is performed on the small horizontal roll welder of Fig. 8. In this case the work is stationary and the furnaces and rolls are moved along the seam. It will be recalled that the opposite was true in the case of the larger vertical welder.

Fig. 9—Welding Head Into 1-Ton Container; Operator Brings Rolls to Bear on Chime While Annular Furnace (Above His Head) Continues to Heat Metal



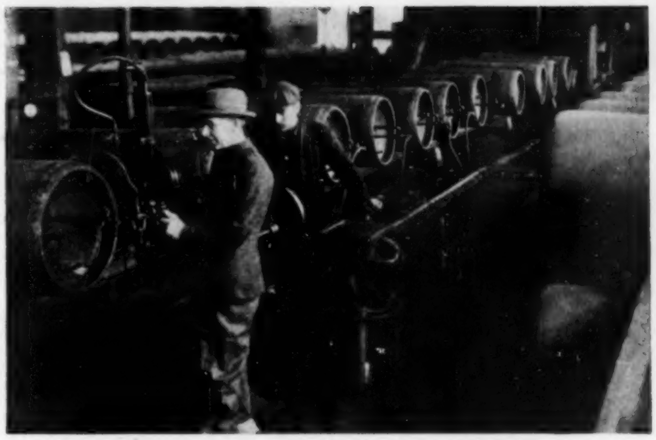


Fig. 10—Inspector, Representing Bureau of Explosives, Putting 500-Lb. Hydrostatic Test on Completed 1-Ton Container, Using Stürcke Testing Machine

The heading operation differs from car tank construction. Dished heads of diameter suitable for a forced fit are pressed into the shell at both ends under hydraulic pressure, the bulge in both cases being inward. Two eduction pipes have previously been welded to the convex side of one head. After the heads have been tacked, the tank is placed in the heading machine, Fig. 9, in which it is supported horizontally on rollers and rotated continuously about its long axis by means of a power-driven chuck. An annular, gas-fired furnace is moved into place at the other end to heat the chime.

This furnace, however, is not completely annular. Through a sector of about 60 deg. which is missing from its bottom, a pair of rolls can be advanced when the metal is sufficiently hot and squeezed together inside and outside the chime. Hence, heating continues, the container rotates, the rolls squeeze, and the weld is completed very quickly. As soon as the joint is perfect, specially shaped rolls are substituted for the welding rolls and, with the furnace still operating, the chime is crimped inward, producing an end of the type in Fig. 10.

Annealing the completed container in an oil-fired furnace, followed by cooling, tapping for three fuse plugs in each head, and attaching a valve-protecting bonnet, are the final steps before the testing. For the test each container is subjected to 500 lb. per square inch hydrostatic pressure and, using methods approved by the Bureau of Explosives, both temporary and permanent expansion are determined. Fig. 10 shows the test being applied. When the container has passed the test to the satisfaction of the inspector, it is dried, plugged at the valve connections, painted, and shipped to the customer.

For permission to inspect these operations and for very hearty co-operation in the preparation of the manuscript, the author is much indebted to Messrs. J. H. Van Moss and C. H. Sharpe, respectively assistant to the president and assistant works manager of the American Welding Company.

CARBON DIOXIDE—

Byproduct or Waste Material?

Are you allowing dollars to go up your stack? In most cases you are not. Mr. Jones explains why.

By C. L. JONES

DryIce Corporation of America
New York

CARBON DIOXIDE is one of the most widely distributed compounds on the surface of the earth. Every place where industrial civilization exists it is produced in such quantities by decay, vital processes, combustion, chemical processes, and fermentation that the supply may be regarded as unlimited. Interest in the significance of carbon dioxide as an industrial byproduct was given its most important impetus by the introduction of solid carbon dioxide as a commercial refrigerant, under the trade-mark "Dry-Ice," by the DryIce Corporation of America in 1923.

This company, much to the surprise of most well-informed technologists in the refrigeration, chemical, and combustion fields, succeeded in marketing solid carbon dioxide at prices from 10 to 20 times the price of water ice per unit of refrigeration, and applied for broad patent coverage on the methods which made commercial use possible at price levels from 5 cents to 12 cents per pound of solid carbon dioxide. These patents have been built into a fairly sizable patent structure covering many phases of the new art, a portion of which is being adjudicated. At the same time many minds have succumbed to the allure of a new and popular material, and the patent art on solid carbon dioxide has grown both in the United States and in other countries at a rapid rate.

One consequence of all this interest has been to direct attention to recovery of byproduct carbon dioxide from lime-kilns, chemical processes, fermentation, cement plants, wells, and various other sources. It is the purpose of this article to discuss briefly some of the factors affecting such byproduct recovery.

Two propositions can first of all be set up as axiomatic:

1. Whether the sale of solid CO_2 is in the hands of one group or many, there is a real cost competition among the sources of supply for a given market. Survival must ultimately be enjoyed by the sources and processes having the least net cost under the conditions that exist. It is of no consequence that a process could supply the market more cheaply at some other volume of demand, freight rate, power cost, or purity, if it cannot do so under the conditions that actually exist during the early portion of its useful life.

2. Since carbon dioxide in an impure state is available in vast quantities comparable to the supply of water, oxygen, or nitrogen, it has no intrinsic value in an impure state. Its value is what it will bring in the market, defined as selling price determined by all factors of volume of demand, selling and transportation costs, location, and other conditions; less in each case, all the costs of purifying, preparing for market, transporting, and selling the particular supply under consideration. The balance is available to cover profit and whatever arbitrary value may be applied to the impure carbon dioxide at its source. It need hardly be stated that this balance is not always a positive quantity.

Factors affecting byproduct CO_2 recovery may be conveniently grouped as technological factors and economic factors. The play of these factors gives a constantly changing picture. Just as the entire fabric of our supply of liquid fuels has changed from the time when over 50 coal-oil refineries, operating on coal, thrived in Pennsylvania, with the discovery of new fields and the development of new uses for the products in automotive and aeronautic transportation, so changes, on a very much smaller scale, of course, must come in the development of the solid carbon dioxide industry.

It would be equally futile to cling to a coal-oil refinery with petroleum available near by, or to invest huge sums in oil wells and refinery equipment, anticipating development of the market by too long a period. Either type of mistimed action leads with equal certainty to ultimate loss. Only by careful study of all the factors involved in supplying a market can serious blunders be avoided.

AMONG the technological factors the first is perhaps the selection of the right purification process. There is no such thing as any best process for purifying carbon dioxide.

A few sources rich in CO_2, such as alcoholic fermentation, chemical byproduct gases, and certain gas wells, permit of liquefaction after removal of only traces of impurities, which may include permanent gases, sulphur, hydrocarbons, and odorous materials. Removal of these impurities is essential and is by no means a minor problem. Where such removal can be cheaply accomplished, however, and where other economic factors do not prevent marketing a sufficient volume of product within economical shipping radius, these sources enjoy a real advantage over gases containing less than 50 per cent carbon dioxide.

A second class of sources containing less than 50 per cent CO_2 is available in much larger quantities, increasing in volume available with decreasing carbon-dioxide content. Below 15 per cent the quantity becomes so great as to justify the belief that no gas containing less than 15 per cent CO_2 has any value as such beyond a possible convenience value in isolated cases. With such gases the purification process selected may be absorption in water, alkali carbonate solutions or other solvents, or may depend on direct condensation of CO_2 under pressure or by low temperature.

Many such processes suggested have never been worked commercially on a sufficient scale to fix costs. Therefore, it is rather dangerous to generalize. Purification processes must be closely scrutinized, however, to determine total cost of fuel, plus other material, plus labor, plus heat, plus power used. Impressive savings in raw material or power cost readily disappear if small volume of market or excessive heat requirement offset them.

ANOTHER FACTOR of prime importance is obsolescence. The chances of investment becoming worthless by progress of the art must be carefully weighed or obsolescence on fairly good process equipment will ultimately become a very large factor in plant costs. Older industries occasionally can predict obsolescence with fair accuracy; young ones seldom can.

The present value of byproduct CO_2 is, however, governed more by economic than by technological considerations. Volume of demand in every industry is a question of price, and saturation is reached for every price at some more or less definite volume.

There can be no question but that the long range cost and price trend in the solid CO_2 industry is downward, and that the prospect for increased volume also is excellent within reason. A responsible producer, knowing that greater returns accrue from large-scale operation on small profit margin, will reduce prices just as fast as is economically possible. A reduced price, however, based on an assumed market without careful analysis of the existing market and good probability (based on experience in the business) that the reduced price will actually produce the assumed increase in volume, is hazardous to say the least.

Economy of use must be considered in relation to density of population. Solid carbon dioxide is a perishable commodity, and the shrinkage involved is a function of mass handled. The curve of distribution losses and costs, therefore, naturally mounts sharply with decreasing population density. This factor, rather than any question of merchandising, has resulted in confining the bulk of solid carbon dioxide used in the past to the larger centers of population. Distribution outlets are steadily being expanded in cities of moderate size, but conservative handling of such expansion is essential to economic success.

It will be apparent by now to the most casual reader that the above is largely couched in generalities. Indeed, any other type of discussion at the present time would be far more likely to be misleading than informative. Each case must be made the subject of a thorough study to determine not only probable cost of production and probable available market but to fix as far as possible the position of competitive sources of supply. It must be remembered that a new source of supply at a lower cost immediately depreciates the value of supplies previously developed. Such a source can succeed in thus depreciating pre-existing sources, however, only when its development proceeds along sound lines and when it in turn is not menaced by depreciation from still cheaper sources.

AN INSTANCE of a common source of misimpression will be of interest. Records of a recent period of operation of the largest manufacturer of solid CO_2 show cost of electric power ranging from $0.88 per ton of finished product to $15 per ton. It is at once apparent that there must be, and is, a wide divergence in conditions. The producer continues to manufacture solid CO_2 at both points for the simple reason that, in the first instance, minimum power cost is an important if not a controlling factor; in the second instance it is not. Incidentally, the technological steps necessary to reduce the $15 figure are not difficult.

Sound development of the solid carbon-dioxide industry will depend to a large extent on the thoughtful and conservative handling of those supplies of byproduct carbon dioxide that can be exploited on a firm economic basis, and no others. It is to be hoped that ill-considered engineering initiative, pride of authorship, and unwarranted acceptance of economic fallacy will not militate against such a sound development.

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Study Liquefied Petroleum Gases

MARKETED PRODUCTION of liquefied petroleum gases during 1929 reached a total of 9,925,698 gal., an increase of 120 per cent over the 4,522,899 gal. marketed during 1928, according to the U. S. Bureau of Mines, following the completion of a survey conducted by E. B. Swanson, Acting Chief Petroleum Economist. Through this work, first quantitative data on this recent development in the petroleum industry have been assembled. Information received from representative producers regarding shipments during the first five months of 1930 indicates that the rate of growth established during 1929 is being continued. Of the 1929 distribution, 113,080 gal. was shipped outside the United States, principally to Canada and Hawaii.

As was discussed previously in *Chem. & Met.* (37, 1930, pp. 103, 104), the principal part of these gases, as now marketed, consists of liquefied propane and butanes derived from natural gasoline in the process of removing its more volatile fractions. Their annual marketed production since 1922, according to the Bureau, is as follows:

	Gallons		Gallons
1922	222,641	1926	465,085
1923	276,863	1927	1,091,005
1924	376,488	1928	4,522,899
1925	403,674	1929	9,925,698

Gas plants and other industrial users have increased rapidly in numbers. Domestic users of "bottled gas" have increased from 20,000 in 1928 to 55,000 in 1929. Prices per pound to these customers ranged from 9.5 cents to 14.5 cents according to location and distance from the supply source.

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Peanut Shells Possible Cellulose Source

RAYON from peanut shells is under investigation by the Farm Wastes Division of the Department of Agriculture at Arlington Farms, Va., with results which seem to promise a large raw-material supply for viscose producers. Over 70,000 tons of peanut hulls are collected annually in Southern shelling plants, but little use is made of them except as fuel for plant power. The fact that the hulls are collected is a point in their favor, since many other types of waste which might be used could not be made available in bulk without heavy collection costs. Research shows that a product up to 90 per cent alpha cellulose content can be derived from peanut shells, the requirement of good rayon material thus being satisfied. Experimental fibers have been produced.

Laminated Glass Absorbs Attention of Three Industries

The two industries primarily affected by the advent of "sandwich glass" were the suppliers of the essential materials, pyroxylin plastic and thin sheet glass. The union of the latter into laminated stock meanwhile created a new industry, the developments and problems of which, while inseparably linked to its parents, are the subject of special treatment on these pages.

By JAMES F. WALSH
Vice-President, Celluloid Corporation, Newark, N. J.

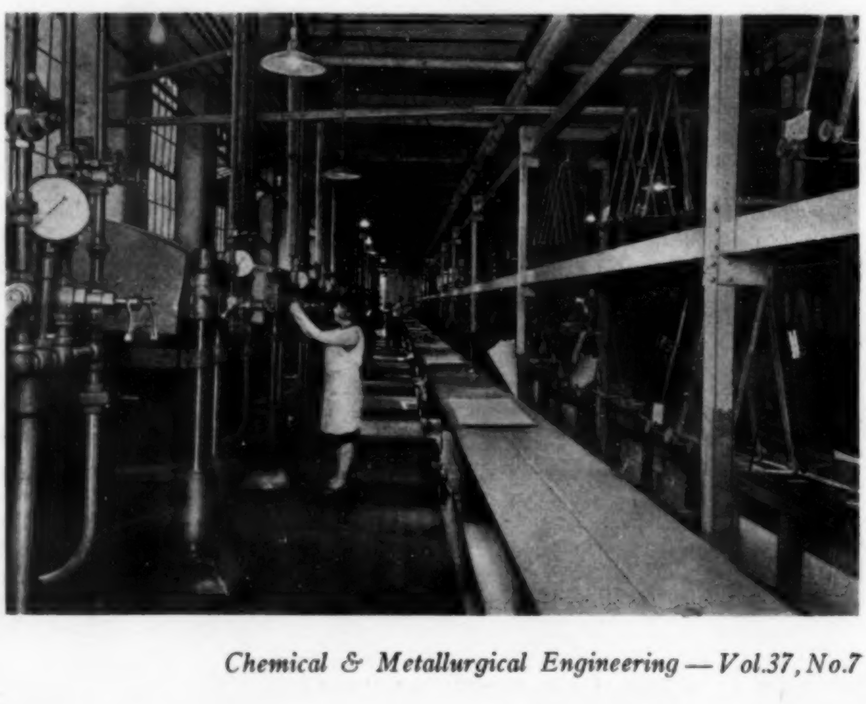
NEVER has the force of necessity been better demonstrated than in the recent establishment and growth of the laminated-glass industry in this country, mainly through the adoption of one of its products by the automotive industry for windshields, deflectors, and windows to replace ordinary window or plate glass. Although conceived by John Crewe Wood and patented in 1906, it was not until 1914 that it began to attain any commercial significance. A war-time demand for non-shatterable glass for gas-mask and aeroplane goggle lenses accounted for the growth during this period. But it was after the war—with the advent of the closed automobile, a serious crime problem in the form of bank-cage robberies, the demand for transparent protective safety shields in plants, a demand for decorative effects in dresser and desk tops—that the real possibilities, importance, and magnitude of the industry became apparent.

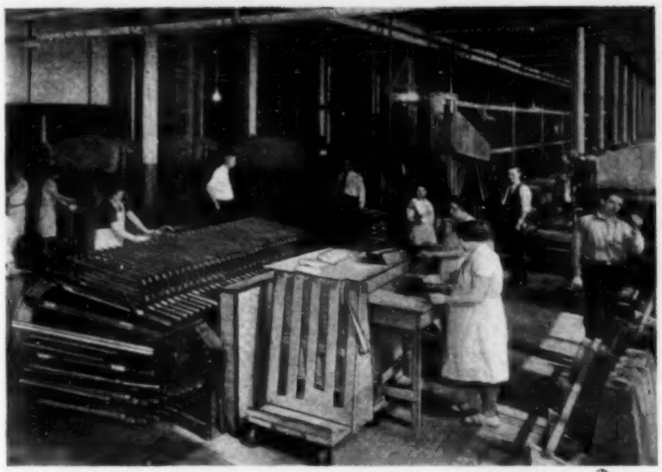
From an industry, during the war period, consisting of three small companies representing a total investment of less than $100,000, it has grown within the past five years to one comprising 12 well-established companies representing an investment of $25,000,000 to $75,000,000. Evidence of its growth also lies in the fact that during the early stages the total output of the industry was about 3,000 to 5,000 pieces of glass per day, whereas now it is 50,000 to 75,000. It is significant to note that this tremendous expansion has been made possible principally through the automotive industry, but that the expansion that will ultimately be required in order to serve the general demand for its products is still to be realized.

Unquestionably, the importance of this new industry is definitely assured; therefore, it is not surprising to find it receiving the attention of not only the financier but the scientist and engineer as well. This development has not been unlike many others in that during its early stages and until it had been fairly well established as an industry, little money, well-directed thought, or scientific and engineering effort was expended by those directly associated with it. However, the neglected child is now receiving its due attention and this will undoubtedly, as in other cases, result in a healthier development.

In structure, the product is primarily a sandwich comprising two glass sheets with a pyroxylin plastic filler, bonded by means of various adhesives. But, depending on the application, many variations may be employed. Thus, there are non-scatterable automotive glass made up of two pieces of glass with an interposed sheet of transparent cellulose plastic; bullet-proof glass composed of two outer layers of thin glass, a core of heavy glass with interposed transparent sheets of cellulose plastic; table, dresser, and desk tops with two pieces of glass with decorative sheets of cellulose plastic; burglar-proof glass; glass for public conveyances; goggle lenses and eyepieces; signal lights; various display signs; aquariums; unbreakable mirrors; windscreens and protective shields for ships; transparent protective screens for mills, and trans-

Line of Production in Plant of Triplex Safety Glass Company at Clifton, N. J. At Right Are Conveyors for Joined and Unjoined Sheets; At Left Are Presses for Joining Sheets





Inspection and Finishing at Discharge End of Laminated Glass Production of Triplex Safety Glass Company

parent or decorative protective inclosures or containers.

The early product suffered from many inherent defects, such as poor bonding of the glass to the cellulose derivative layer, because of unsuitable processes and undeveloped technique; abnormal discoloration and failure of the cellulose plastic, due to lack of available materials of suitable character and quality; absence of sources of supply of suitable flat sheet or plate glass, due to lack of demand in fields other than the laminated-glass industry itself. Influenced greatly by the limitations of the available glass and cellulose plastic products, it was not until economic conditions allowed the scientific and engineering forces of these industries to co-operate intensively on the various problems that any real progress and perfection in the product was attained. Evidence of this is apparent in the quality and processes today in comparison with five or ten years ago.

Glass companies, through the development of continuous processes, have contributed flat sheet glass and, by perfection of their plate-glass process, $\frac{1}{8}$-in. plate glass has been made available. As pointed out, the best known product, automotive non-scatterable glass, is composed of either two sheets of $\frac{1}{8}$-in. plate glass or two sheets of drawn sheet glass with an interposed sheet of pyroxylin plastic material. The cellulose derivative plastic industry, through improved methods and formulas, has contributed pyroxylin plastic materials with essentially the same transparency and freedom from defects as the plain glass, while stability to light now meets usual service requirements.

There are, broadly, two types of processes recognized and practiced: the dry and the wet or semi-wet process. In both of them considerable variations are practiced in the composition of the bonding media and in the conditions under which the cementing process is accomplished. In general, however, the procedures followed in the respective processes are as here outlined.

Dry Process—The glass and pyroxylin plastic sheet are inspected and cleaned thoroughly. The cleaned dried glass is then coated or sprayed with an aqueous solution of glue or gelatinous cement containing a small quantity of preservative to prevent it from becoming rancid and losing its adhesive qualities. The cleaned sprayed glass is then dried in a predetermined regulated atmosphere to the desired degree of dryness of the coating. The cleaned, dried, pyroxylin-plastic sheet material is then assembled between the coated dried glass in the form of a sandwich. The sandwich is then placed in a rubber bag with suitable templets and carrying plates, the bag sealed and subsequently evacuated (or placed in a platen or expanding plate press) and subjected to heat and pressure. The usual conditions are a treatment of 7 to 15 minutes at 220 to 250 deg. F. under a pressure of 150 to 250 lb. per square inch. In some instances the sandwich is cooled under pressure. In most processes this is not essential but offers some slight advantages in elimination of press defects.

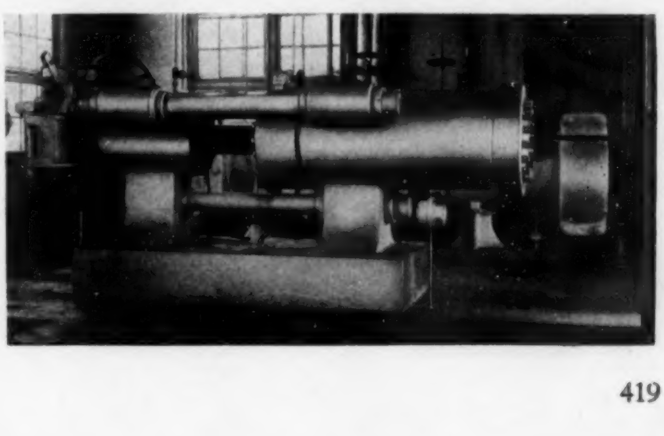
The set, consisting of the sandwich, templets, carrying plates, and padding, is then discharged from the press or autoclave and disassembled, cooled, and the laminated glass sandwich inspected. After inspection the edges are ground and polished in the usual type of glass-edge grinding and polishing machines. Where it is to be sealed, the pyroxylin plastic is removed from the edges for a depth of $\frac{1}{16}$ to $\frac{1}{8}$ in. by means of special grooving machines. The ground, grooved sandwich is then passed to a sealing machine where the edge sealing compound—pitch or resinous composition—is mechanically applied to the groove. The glass is then cleaned, inspected, and packed ready for shipment.

Wet or Semi-Wet Process—The glass and pyroxylin plastic sheet are inspected and cleaned thoroughly. The dried cleaned glass is then sprayed or coated with a special composition, usually a resinous lacquer coating, and the coating dried under predetermined regulated conditions to the desired degree of dryness. The cleaned dried pyroxylin plastic sheet is sprayed, dipped, or coated with a so-called intermediatory bonding solution, generally a composition made up of a mixture of high boiling solvents and substantially low vapor pressure plasticizers, the purpose being to soften the surface of the pyroxylin plastic sheet and the coating or lacquer on the glass. It is important that the solvent activity of the intermediatory bonding solution be very definitely and carefully controlled. The coated glass and treated pyroxylin plastic sheet is then assembled into a sandwich and the whole placed in a press or autoclave and subsequently processed under substantially the same conditions as in the case of the dry process.

There has been considerable discussion as to the merits of the respective type processes, but to date there is no conclusive evidence of the superiority of either. Each, on the other hand, has, depending on the type of cementing or bonding medium and the type of equipment, its own peculiar advantages. At the present stage of development it is evident that future work will ultimately find a definite place and utility for both.

The equipment used in the industry varies considerably

Pyroxylin Plastic in Dough-Like Consistency is Filtered Under Heat and Pressure to Remove Dirt and Impurities



Rolled Pyroxylin Plastic Being Consolidated Into Blocks; Three Heats (or Chases) May Be Seen in One Press

and in general is of special design and construction. Various types of hydraulic presses from single to four and five openings are used, autoclaves varying in construction from the cylindrical to the rectangular type, and some few special designs of expanding platen type presses. The washing, spraying, coating, and handling equipment is all specially designed to meet the specific requirements of each individual process. The details of design and construction of the equipment and the processes are all jealously guarded and considered of a highly confidential nature. It is in view of this that it is impossible under the circumstances to enter into any great detail on the various processes. The equipment and processes are the subject of innumerable patents and pending patent applications.

It is of interest to note that although considerable progress has been made, the industry still has some serious problems to contend with, chief among which are breakage in process, let-goes and discoloration in service, and lack of uniformity of the finished product. Some difficulty has been associated with bubbles, but this has largely been overcome by recent developments.

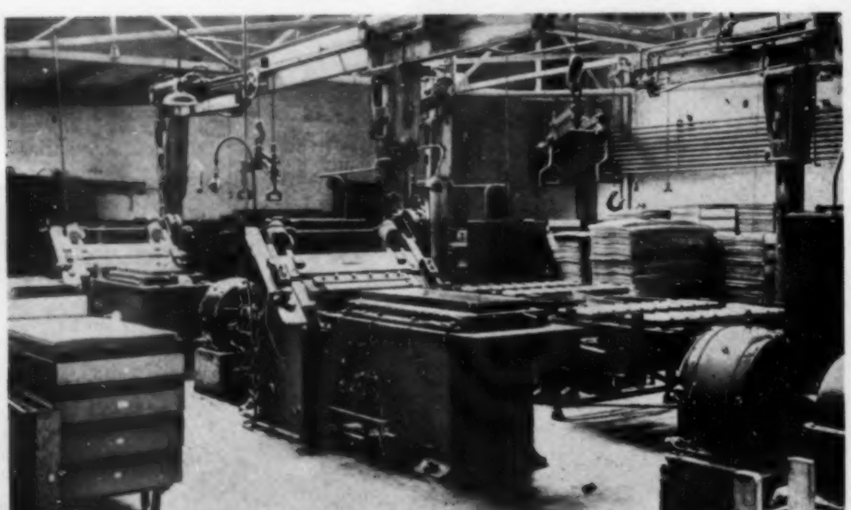
The severity of the service requirements and the high standard of quality to be met, however, are a genuine problem, since the finished product finds its way to the extreme conditions of the polar regions and the tropical sun, and yet must meet the close-range scrutiny of fickle public purchasers of automobiles and airplanes. To cope with these standards it can be appreciated that many thousands of dollars had to be expended by the glass manufacturers, the pyroxylin plastic producers, and the industry itself in research and improved process and products.

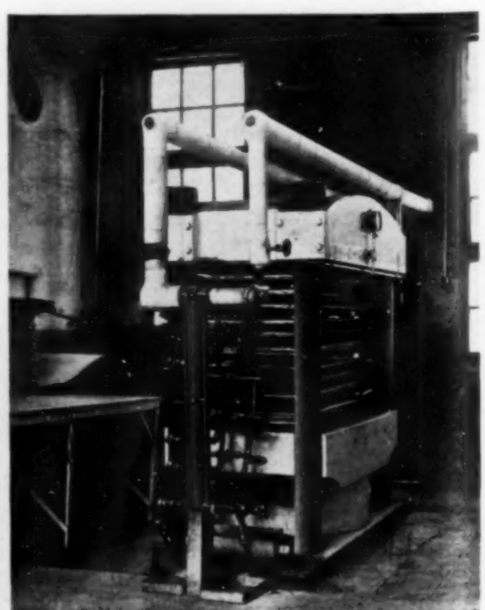
A great part of this responsibility has been the lot of the pyroxylin plastic manufacturer, through whose wholehearted and effective response the present status of the laminated-glass industry has been attainable. An organic material processed, for economic reasons, by methods limiting in many instances the quality to be obtained, has been so improved that it is substantially as free from undesirable defects as the glass itself. Every effort is being made to establish fair reasonable standards, which should reflect in further improvement.

As previously pointed out, at present the chief limiting factors of permeability are the limited definite resistance toward exposure to light and heat and the lack of uniformity in quality. The former is associated primarily with the limitations of the pyroxylin plastic materials and to a lesser degree with the composition and quality of the glass. The latter is due entirely to the lack of fundamental information of the actual functions of the laminating process, resulting possibly from the fact that up to the present time the energy and attention of the industry has been commanded by their desire to produce a product at the expense of a thorough knowledge of its functions. It can, therefore, be seen that a very fertile field is yet open to the research man and investigator, so that any effort expended should be well rewarded if the results in any way improve either of these basic conditions.

Much work has been done and is likely to be continued in the search for some substance possessed of the characteristics of the pyroxylin plastic materials but better suited to match the service life of glass, but to date nothing tangible has resulted. Other cellulose derivatives, ethers, esters, and various resins have been investigated, and there is reason to believe that in the light of

Blocks of Pyroxylin Plastic Are Sheeted Into Various Thicknesses by Motion of the Supporting Bed Toward a Stationary Knife, as Below. When Polished Sheets Are Required, They Are Pressed Between Polished Nickel-Plated Sheets Under Heat, as on the Right





recent chemical developments in these fields, there is still something in the offing.

The most promising of the substitutes for pyroxylin plastic appear to be cellulose-acetate plastics, offering as they do, because of their chemical constitution, greater resistance to decomposition in light and heat when properly compounded. Limited only by a slight tendency toward brittleness, they appear well on the road to finding a definite place in the industry. They are at the present time finding limited use where requirements are such they cannot be filled by the pyroxylin plastics, as in tropical climates and where the glass is to be exposed to a moderately high temperature for longer periods of time. The problem of obtaining a satisfactory bonding is now fairly well solved.

Evidence of public recognition of the industry's products is best illustrated by the definite legislative steps that have been taken in two states to the effect that all vehicles used for public conveyance be equipped with laminated glass. This, in addition to the fact that several of our largest municipalities and public traction companies are requiring taxicabs and omnibuses under their jurisdiction to be equipped with laminated glass. These facts, coupled with increasing public interest, very definitely indicate that this "chemical sandwich" will soon be recognized as one of the most important single contributions to the cause of safety and prolongment of life yet offered under modern conditions.

In conclusion, a complete list of U. S. patents, down to March, 1930, is offered in the table below.

List of U. S. Patents Pertaining to Laminated Glass

Number	Date	Inventor	Description
280,745	7/ 3/1883	J. W. Hyatt—Celluloid Corp.	Press or mold for coating article with celluloid.
297,098	4/15/1894	W. H. Wood.	....
346,864	8/ 3/1886	Wm. Read Jr. Assigned — Boston - Trans-Phototype Co.	Transparency.
364,324	6/ 7/1887	E. Weis.	Process of cutting very thin parts upon glass articles.
610,861	9/13/1898	Hannibal Goodwin.	Photographic pellicle and process of producing same.
765,275	7/19/1904	Moses M. Fields.	Process of producing pictures.
830,398	9/ 4/1906	John Crewe Wood.	Transparent screen — Canada balsam.
831,640	9/25/1926	A. B. Walsh.	....
886,883	5/ 5/1908	J. H. Smith.	Manufacturing of films.
1,019,407	3/ 5/1912	L. H. Baeckeland—Gen. Bakelite Corp.	Method of uniting objects.
1,098,342	5/26/1914	E. Benedictus.	Celluloid sheets softened by acetone, etc.—No cement on glass.
1,108,329	8/25/1914	M. J. Callahan—Gen. Elec. Co.	Condensation products (glycerine and phthalic anhydrid).
1,128,094	2/ 9/1915	E. Benedictus.	Use of vacuum—curved sheets—no cement on glass.
1,153,859	9/14/1915	L. W. Brigter—Amer. Optical Co.	Ophthalmic lenses—using borate or silicate as cement.
1,182,739	5/ 9/1916	E. Benedictus.	Gelatine—alcohol process.
1,206,656	11/28/1916	E. Benedictus.	Press platens.
1,210,987	1/ 2/1917	Andre Roosevelt—Assgr. Glass Founders Corp.	Using gelatine and a solvent for both gelatine and celluloid—formic acid.
1,222,049	4/10/1917	E. D. Tillyer—Amer. Optical Co.	Ophthalmic lenses with coatings for selective ray transmission.
1,223,135	4/17/1917	Abel Bardin.	Varnish—gelatine method.
1,223,583	4/24/1917	H. K. Hitchock—Assgr. Pitts. Plate Glass Co.	Alarm—glass.
1,241,738	10/ 2/1917	F. Klatte and A. Rollitt.	Vinyl esters.
1,228,165	5/29/1917	Abel Bardin.	Coating of celluloid on single piece of glass.
1,274,205	7/30/1918	C. & V. Shuman.	Celluloid and enamel coat—vacuum.
1,274,206	7/30/1918	C. & V. Shuman.	Autoclave.
1,285,226	11/19/1918	W. G. King—J. King Optical Co.	Laminated lenses with clear center.
1,324,361	12/ 9/1919	C. & V. Shuman—Super Glass Co.	Celluloid—Heat and pressure.
1,334,588	3/23/1920	Louis Bartelstone.	Compensating press.
1,340,189	5/18/1920	E. D. Tillyer—Amer. Optical Co.	Phenol—shellac as intermediate layer in lenses.
1,342,267	6/ 1/1920	Leon Francioie Mascart.	Gelatine — enamel coat — celluloid and solvents, (acetic acid, alcohol, etc.)
1,342,268	6/ 1/1920	Leon Francioie Mascart.	Gelatine—roughened surface to get greater adhesion.
1,342,282	6/ 1/1920	M. W. Gleason.	Laminated glass globes.
1,355,384	10/19/1920	Hanns John.	Condensation product — aldehydes and carbamid.
1,355,625	10/12/1920	V. Shuman—Super Glass Co.	Laminated Wire glass.
1,368,954	2/15/1921	Otto S. Marckworth.	Decorated laminated glass.
1,415,236	5/ 9/1922	R. A. Gibbs—Safetee Glass Co.	Laminated headlight.
1,421,974	7/ 4/1922	Otto S. Marchworth.	Use of solvents rendered active by heating.
1,460,606	7/ 3/1923	Kurt Ripper.	Formaldehyde urea condensation product.
1,467,030	9/ 4/1923	V. C. Edwards—DuPont Co.	U. V. absorbent glass for lamination.
1,478,862	12/25/1923	H. Rosenthal.	Use of glass and celluloid—softening agent for glass and celluloid.
1,494,473	5/20/1924	E. S. Farrow—Eastman Kodak.	Cellulose—ether solvent and composition.
1,500,039	7/ 1/1924	V. Shuman—Safetee Glass Co.	Indicator plate and printing.
1,512,267	6/ 1/1920	Mascart.	....
1,548,490	8/ 4/1925	C. Shuman & A. G. Worrall—Assgr. Safety Glass Co.	Bullet-proof glass.
1,553,667	9/15/1925	W. C. Bull.	Apparatus for laminating—autoclave type. Elec. heating.
1,554,308	9/22/1925	H. A. Gardner.	Use of toluene sulfoamid aldehyde resin in film.
1,575,969	3/ 9/1926	W. C. Bull.	Autoclave method.
1,592,228	7/13/1926	A. Shuman—Penn. Wire Glass.	Corrugated wire glass.
1,604,761	10/26/1926	J. H. Sherts—DuPont Co.	Actinismproof reinforced glass.
1,611,139	10/14/1926	Louis Bartelstone.	Castor oil process.
1,632,363	6/14/1927	W C. Bull.	Laminated glass with wire strips.
1,644,131	10/ 4/1927	Edward Hope.	Use of itaconic ester as adhesive.
1,645,580	10/18/1927	E. S. Bock.	Autoclave—flexible bag.
1,646,097	10/18/1927	Michael Liptak.	....
1,647,435	11/ 1/1927	J. H. Clewell.	....
1,651,581	12/ 6/1927	W. F. Brown—Libby-Owens	Cellulose formate as an adhesive.
1,653,040	12/20/1927	J. L. Drake—Libby-Owens.	Laminated mirror.
1,655,933	1/10/1928	H. T. Allen—Libby-Owens.	Use of tetralin.
1,656,691	1/17/1928	W. F. Brown Libby-Owens.	Canada balsam.
1,657,227	1/24/1928	W. Owen—Pitts. Plate Glass.	Apparatus for laminating — special type autoclave.
1,665,413	4/10/1928	P. H. Head.	Use of chromatic stabilizing agents; also tetrachlorethane.
1,666,252	4/17/1928	Louis Bartelstone.	Splicing celluloid in laminated glass—use of clamps.
1,667,832	5/ 1/1928	Louis Bartelstone.	Apparatus for laminating under incremental differential pressures.
1,668,853	5/ 8/1928	B. Long.	Process of uniting vitreous pieces with phenol-formaldehyde condensation product.
1,669,044	5/ 8/1928	Frank Fraser—Libby-Owens.	Celluloid containing vegetable or castor oil.
1,670,435	5/22/1928	W. F. Brown Libby-Owens.	Animal oil.
1,670,436	5/22/1928	W. F. Brown—Libby-Owens.	Mineral oil.
1,676,281	7/10/1928	Ivan Ostromislensky.	Process for making powdered vitreous polymerized styrol.
1,677,753	7/17/1928	Otto Drossback.	Cellulose derivatives with an ester of an ethylene dicarboxylic acid with a non-aromatic alcohol.
1,682,280	8/28/1928	A. C. Johnston—Hercules Powder.	Process of preparing alkyl esters of abietic acid.
1,683,404	9/ 4/1928	Ivan Ostromislensky.	Polymerized styrol.
1,692,619	11/20/1928	W. F. Brown—Libby-Owens.	Parallel waves in sheet laminations.
1,693,729	12/ 4/1928	J. W. H. Randall—Libby-Owens.	Rubber in laminated glass.
1,686,942	....	J. H. Shielkin.	....
1,697,275	11/ 1/1929	H. L. Gray.	....
1,698,371	1/ 8/1929	W. O. Lytle—Pitts. Plate Glass Co.	Apparatus—autoclave type.
1,701,147	2/ 5/1929	J. L. Drake—Libby-Owens.	Camphorated oil.
1,703,122	2/26/1929	H. J. Shielkin.	....
1,705,631	3/19/1929	Louis Bartelstone—Indestructo.	Sealing.
1,719,930	4//221929	H. Gray.	....
1,725,454	8/20/1929	G. E. Heyl.	A method of avoiding trapping air bubbles when assembling sandwich.
1,727,937	9/10/1929	J. W. H. Randall—Libby-Owens.	Fabric coated as interlayer.
1,729,125	9/24/1929	J. A. Reece—Libby-Owens.	Automatic process.
1,731,820	10/15/1929	S. J. Lewis—Libby-Owens.	Cutting of laminated glass.
1,732,022	10/15/1929	W. O. Lytle—Pitts. Plate Glass Co.	Laminating by direct fluid pressure protecting edges only.
1,732,023	10/15/1929	W. O. Lytle—Pitts. Plate Glass Co.	Special container for autoclave process.
1,734,379	11/ 5/1929	H. K. Hitchock—Pitts. Plate Glass Co.	U clips to protect edges of glass in pressing.
1,734,380	11/ 5/1929	H. K. Hitchcock—Pitts. Plate Glass Co.	Special container for autoclave process.
1,738,228	6/24/1929	F. N. Campbell & J. Myatt.	....
1,738,229	6/24/1929	F. N. Campbell & J. Myatt.	....
1,746,826	2/11/1930	Thomas H. P. Farr—Triplex.	Sealing laminated glass and apparatus therefor.
1,751,051	3/18/1930	W. E. Nobbe—Libby-Owens.	Laminating in one piece several small pieces of celluloid and then cutting.

Applying Naval Stores in the Process Industries

By R. C. PALMER
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THAT branch of the naval-stores industry utilizing as its raw material the fat pine stumps and resinous wood from cut-over lands by the steam and solvent process manufactures as its primary product steam-distilled wood turpentine, steam-distilled pine oil, and wood rosin. In the course of this manufacturing process there also are produced secondary and modified products to meet special requirements of consuming industries.

Turpentine, next to pine tar, is the oldest known naval-stores product. For many years no attempt was made to recover rosin and it was thrown away as a waste product. The most recent figures on the production of turpentine in the United States give a total of about 30,000,000 gal., of which about 4,000,000 gal. was produced by the steam and solvent process. Since the United States is by far the largest producing country, a large part of the production is exported, this figure amounting to about 40 per cent of the total. About 18,000,000 gal. of it is left for domestic consumption. Manufacturing industries use only about one-third of this, the remainder being bought by the general public. Except for a comparatively small quantity for medicinal purposes, this public consumption is used for general household painting and decorating. Industrial uses of turpentine as given by the Bureau of Chemistry of the Department of Agriculture for the year 1928-1929 are given below in round numbers.

	Gallons
Paint and varnish	4,300,000
Shoe polish	560,000
Automobiles and wagons	160,000
Sealing wax and other plastics	68,000
Chemical and pharmaceutical	55,000
Oils and greases	43,000
Shipyards, car shops, etc	51,000
Foundries	15,000
Printing ink	10,000
All other uses	45,000

Under the heading of automobiles and wagons, ship yards and car shops the use is undoubtedly for painting, bringing the total for paint and varnish to about 4,600,000 gal., or approximately 87 per cent of the total. These figures simply mean that the chief industrial use for turpentine is as a vehicle, thinner, or solvent, and this includes not only products like varnish but also its use in shoe polish, oils, greases, plastics, and ink.

What are the properties of turpentine that indicate its value for industrial uses? The U. S. Department of Agriculture and such organizations as the American Society for Testing Materials have set certain physical standards for turpentine. These specifications are drawn principally to indicate purity rather than working quality. Such properties as specific gravity, index of refraction, initial boiling point, distillation range, and chemical tests for adulteration within limits determined after examination of turpentine from many sources known to be genuine samples, are the basis of these standards. By applying these tests the consumer is protected in his purchases and the producer is enabled to keep the physical quality of his product within specified limits. There are, however, other properties which are of interest for industrial uses.

The manufacturer of varnish is interested in the rate of evaporation, the solvent properties for gums and resin, and also the ability of the chemically unsaturated pinene constituents to absorb oxygen and induce oxidation or drying. It is believed that when turpentine is used as a thinner in coating a porous material like wood, its ability to penetrate and hold the pigment and oil covering is superior to all other solvents used for this purpose. For shoe polish, greases, and plastics the ability to dissolve or hold in emulsion the other ingredients is the important property.

THE principal chemical uses of turpentine are for the manufacture of terpin hydrate, which has some use as a pharmaceutical or may be converted to terpineol, a perfume base, and as a starting material for synthetic camphor. These chemical derivatives start from pinene, so a high per cent of pinene is required when turpentine is used for these purposes.

The manufacturer of steam-distilled wood turpentine has at his disposal chemical and physical treatments in the refining operation which enable him to give the product special treatment or special fractionation when required. Turpentine produced by steam extraction from resinous wood differs slightly from that produced from the live pine tree and this principal difference is the presence of dipentine in small quantity. This terpene is higher boiling than pinene, but has high solvent properties for gums and resins and greater oxygen-absorbent power. Another difference is the absence in the steam-distilled product of a small quantity of aromatic material which gives the gum turpentine its odor. Steam-distilled wood turpentine has the mild odor of its principal constituent. These terpenes other than pinene, such as dipentine, which are present in pine wood are separated in the course of the steam and solvent process into special fractions and these are marketed as special solvents under various trade names. They find a use in varnishes which contain other thinners of less solvent power and as special solvents for rubber and other materials.

Pine oil is the principal other oil recovered from the resinous pine wood. The annual production of steam-distilled pine oil is about 2,800,000 gal. It is a much more complex mixture than turpentine. As it is not present in the living cellular structure of pine wood, its only source is from the dead heart of the tree. Many of the terpenes and terpene products contained in pine oil

can be traced chemically to the pinene of the turpentine, although it has not been possible to reproduce these transformations in the laboratory. In general, the composition of pine oil consists of terpene hydrocarbons and terpene alcohols and a few derivatives of these products.

Terpene hydrocarbons in pine oil boil higher than pinene and the principal ones are dipentine, terpinene, terpinoline, and camphene. As has been mentioned, a large part of this group of terpenes is separated into special fractions in the steam and solvent plant, so the pine oil does not usually contain over 5 per cent of these hydrocarbons. Terpene alcohols comprise the greatest portion of pine oil. These include terpineol, borneol, and fenchyl alcohol. Cineol, found abundantly in eucalyptus oil, is the only oxide that has been identified. There also is found a few per cent of methyl chavicol, a phenol ether.

Of chemical interest are the essential oil constituents of steam-distilled pine oil, and the separation of the more important ones, such as terpineol and borneol, which can be readily oxidized to camphor, has accounted for a large portion of the industrial consumption of this oil. The terpineol content of pine oil will run from 50 to 60 per cent, while the borneol content is not over 5 per cent. It has not been found profitable to process the oil for borneol only.

Standards for identifying pure pine oil have been set by the steam and solvent manufacturers, as they are the only producers. Specifications like those for turpentine define the specific gravity and distillation limits and also moisture, with tests to detect mineral-oil adulteration. Several grades of pine oil are marketed, the principal one being standard pine oil of 0.933 specific gravity. The chief physical difference in the grades is gravity; the higher gravity oils, containing a large proportion of terpineol and borneol, are produced chiefly for the chemical conversion markets.

As has been mentioned before, the complex mixture found in standard pine oil of 0.933 gravity has been of great value in the mining industry as a frother and collector in the flotation processes of ore concentration, and this is the largest single use for pine oil. The value of the separate constituents as flotation reagents is unknown, and it is principally for this reason that the mining industry consumes chiefly the standard product.

Steam-distilled pine oil is an excellent solvent and for this reason finds use in a variety of industries. The high boiling range (190 to 225 deg. C.) indicates relatively slow evaporation and this limits its use in any great quantity in paints and varnishes, although it is an excellent solvent for varnish gums. It is used in paint and varnish removers and as an ingredient for furniture, floor, and metal polishes. Standard pine oil has a characteristic straw color, but its use in varnishes requires a colorless anhydrous grade, so that it may be mixed with petroleum thinners. Water-white pine oil is produced by redistillation of the natural oil over caustic, and the colorless oil is then dehydrated.

Another important use of pine oil is as a cleansing and wetting-out agent in textile manufacture and in dry cleaning and laundry compounds, these uses being based on the high solvent power for greases and vegetable waxes.

Steam-distilled pine oil has a persistent pleasant piney odor and because of this is used in deodorizing preparations for public buildings and street and railway cars. It is also used as a disinfectant, chiefly as a water-emulsifiable soap, as the oil has a high phenol coefficient. Pine oil also has a value as an insecticide and is used alone and as a base in the preparation of mosquito repellents. A wide variety of uses for pine oil have been found as has been indicated, but as the production has kept ahead of the demand, continued research has been necessary to find uses for this unique and valuable material.

The latest available figures on the production of rosin as given by the U. S. Department of Agriculture for 1928-29 in terms of 500-lb. barrels indicated this to be 2,296,000, of which 430,000, or nearly 20 per cent, was produced from pine wood by the steam and solvent process. Fifty-six per cent, or 1,280,000 bbl., was exported, leaving about 950,000 bbl. for domestic consumption. Distribution of this domestic consumption for principal uses also given by the Department of Agriculture are as follows in round numbers.

	Barrels
Paper and paper size	334,000
Paint and varnish	245,000
Soap	183,000
Linoleum	58,000
Oils and greases	49,000
Sealing wax, pitch, insulation and plastics	35,000
Foundries	18,000
Printing inks	15,000
Chemicals	4,000
Matches	3,000
All others	4,000

There are no chemical or physical standards generally recognized for rosin except that of color. Rosin is graded and the price based upon color standard furnished by the U. S. Department of Agriculture. There are 13 of these grades for gum rosin ranging from "B," a dark brown, to "X," a pale lemon, measured in a cube $\frac{7}{8}$ in. thick. Natural wood rosin as extracted by the steam and solvent process has a separate grade, because of its characteristic red color, which is designated as "FF." The paler grades of wood rosin which are now being successfully manufactured do not have any distinguishing visible color different from gum rosin, and they are graded by the gum standards.

Rosin is principally abietic acid, the quantity varying between 82 and 90 per cent. Rosin, therefore, furnishes the world with its most abundant and lowest price organic acid. Color grade is no indication of the quantity of abietic acid present. Wood rosin is very uniform chemically. The natural "FF" grade contains from 82 to 83 per cent. and the pale grades from 86 to 88 per cent abietic acid.

For many uses, color has been a sufficient characteristic to indicate its value and it probably is for this reason that there has been no attempt to compile other standards. The color of the natural "FF" wood rosin limits its use. These uses have been chiefly in the sizing of news and wrapping paper, paper bags, and fiber boards, in linoleum, greases, foundries, printing inks, and matches. The lighter grades of wood rosin, because of the improved characteristic, are used also in soap, paint and varnish, and sizing light colored paper.

For some purposes other properties besides that of color are important. Melting or softening point is one of these. In the manufacture of matches and in dry-core compounds, rosin is used in a powdered condition, and the softening point must be above the normal temperature of handling. This property is important also for plastics, such as sealing wax or shoe box toes. Solubility of rosin is another important property. Used in gloss oils, core oils, and printing inks, it should show no insoluble

constituents or precipitation upon storage of the compound. The natural properties of rosin may be modified if they do not meet specified requirements. This is done in the regular manufacture of wood rosin. Lime is added to rosin to form calcium resinate, which increases the softening point and also reduces the acidity.

Hardening rosin by means of lime is a common procedure in the manufacture of certain types of varnish, such as gloss oil, as rosin treated in this way produces a more rapid drying varnish film. The reduction of acidity is important in all varnish manufacture to prevent action on the drying oil. Rosin enters into varnishes in a number of ways. It may be either limed, as has been mentioned, or combined chemically with glycerin to form ester gum. Practically neutral resins of this latter type are hard and water-resistant and are used in varnishes of good quality. In the more recent developments in varnish manufacture, rosin is used in physical or chemical combination with synthetic resins of the phenol aldehyde type, which form the base of rapid drying varnishes and are also used in lacquers. Combined with metals, such as cobalt, manganese, or lead, to form resinates, rosin is used as a dryer for many paints as well as varnishes. The principal requirements of rosin for paint and varnish are lack of color, high softening point, and cleanliness.

Rosin is used for sizing paper as a sodium soap which is emulsified with the fiber and then acidified with aluminum sulphate. The resultant precipitate is composed of rosin, aluminum resinate, and aluminum hydrate. While color is important for all white paper, the visible color of the rosin is not a guide to the color of the precipitate size. Colors of a potential nature may develop on acidification of the soap emulsion and this is an important problem of wood rosins even of the paler grades. The development of these potential colors can be overcome only by special treatment.

Soaps of the laundry-cake type usually contain sodium abietate as well as do soaps made from animal fats and vegetable oils. For many years soap has been one of the largest uses for rosin. Rosins for soap require good color and as low non-acid constituents as possible. Too great a quantity of non-acid material or resene is not desirable.

The electrical properties of rosin are of interest when used in compounds for electrical insulation purposes. The presence of metal salts and moisture is a factor to be avoided for such uses.

Heat-treating processes which are applied only to wood rosin produce changes in physical properties making them more adaptable for many purposes. One of the principal differences between wood and gum rosin is in optical activity. Wood rosin generally contains more laevo abietic acid than gum, and these special treatments convert a large portion of the laevo to the dextro acid. Laevo acid, being less soluble, tends more to crystallize from solution, and the treatment, therefore, increases the solubility. Such treatments also destroy colors which are not shown in the visible color grade.

Much more detail regarding the properties of naval stores produced by the steam and solvent process in relation to their uses has not been mentioned, but some of the more important ones discussed indicate the highly technical nature of the problems with which the manufacturer has to deal. These problems are either worked out at the plant laboratories or in many instances by the technical service staff of the sales organization. Continued study of the chemical nature of the primary products has resulted in adapting them to the best possible usefulness.

▼ ▼ ▼

Using Inert Gas for Fire Protection

STUDIES of the causes of dust explosions in different types of industrial plants, and methods for their control and prevention, were largely responsible for the continued reduction in these losses during the year, according to the report of Dec. 2, 1929, of the chief of the U. S. Bureau of Chemistry and Soils. The work of that bureau indicates very definitely that practically all types of combustible dusts are explosive when mixed in proper proportions with air and that nearly 30,000 industrial plants in the United States are liable to this risk. More than a million and a quarter people are employed in these plants, which manufacture products having an annual value of $10,000,000,000.

A great increase in the use of inert gas for fire and explosion protection has followed the publication of Technical Bulletin No. 74, entitled "The Value of Inert Gas as a Preventive of Dust Explosions in Grinding Equipment," which describes the investigations made at Arlington farm that clearly demonstrated the value of inert gas for such purposes.

In addition to the previous reported inert-gas installations made at two hard-rubber grinding plants, a cork grinding mill, a Pyrethrum-flower grinding plant, and a number of sulphur-grinding mills have adopted this method of preventing explosions, and a feed-grinding plant in the Middle West is now installing one of the largest inert-gas systems in the country. The use of inert gas to provide protection in one of the large starch plants is being considered, and experiments are under way to develop methods of properly cleaning and conditioning the gas for such use. Fire extinguishers filled with inert gas under pressure, instead of chemicals, are now being produced and are finding a ready market in this country.

Methods of cleaning and conditioning flue gas to render it satisfactory for use as a preventive of dust explosion and fires are now being developed at Arlington farm. Two types of washers employing wooden grids, limestone, and water sprays have already been tested. Experiments with silica gel and aluminum gel to develop a method of removing moisture and objectionable fumes are also being made.

Preliminary plans have been made to carry on experimental work to determine the value of inert gas for fire protection in cotton gins. The introduction of electrical power has eliminated the possibility of using steam, which was formerly employed to extinguish fires in the lint flues. A reduction in insurance rate for an installation where steam was used for this purpose has been granted. It is hoped that inert gas can be used where steam is no longer available and a similar or larger reduction in insurance obtained. Data on fire losses in the various states have been obtained and conferences held with manufacturers of inert-gas fire-protection equipment. Conferences with cotton ginners and insurance company representatives have been planned.

New Mill Brings Economies to Asphalt Emulsion Industry

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WITH emulsified asphalts rapidly assuming a position of primary importance in the field of construction and industrial products, because of the unprecedented increase in their volume consumption, it is not at all surprising to find that the chemical engineer has been contributing valuable assistance to the industrial chemist in this new and rapid development.

The chemistry of asphalt emulsions is rather old (some 40 to 45 years), but the chemical engineering is of more recent origin. The chemist long ago discovered how to make so-called "immiscible" substances such as oil and water, quite "miscible" one in the other by means of the addition of substances now designated as "emulsifying agents."

In this particular field of chemistry the terminology has changed considerably, especially since 1906, when much of our present-day nomenclature in physical and colloidal chemistry assumed more definite form. Prior to that date, many patents were issued on the art of emulsifying asphalts and other bituminous materials, many of which, strange to say, have been "repatented" as new inventions, because the old terminology has been cleverly rewritten in the light of the newer nomenclature. This condition has resulted in much confusion in the patent art study, since up to date some 5,000 patents have been issued, about 1,800 of which are as yet unexpired.

The batch method, of course, was the natural early mode of production. In the Headley Good Roads Company's plant at Marcus Hook, Pa., paddle mixers of 2,000 gal. capacity and producing batches at the rate of 1,200 gal. per hour were operated in batteries of three, on a nine-hour day schedule. Each battery of mixers produced six batches daily of 5,400 gal. each, or 32,400 gal. per day. These batteries of three mixers occupied approximately 300 sq.ft. of floor space and required 40 hp. for regular production.

At a later date members of the technical staff of this company constructed and put into operation continuously operating machines with a capacity of 3,600 gal. per hour, or 32,400 gal. per nine-hour day. Each machine of this capacity thus replaced each battery of three batch mixers, with equal output, reduction of floor space to 50 sq.ft. and reduction of power to 35 hp. Thus, the uncertainty of batch operations and lack of uniformity were eliminated, without any decrease in output, and with decrease in floor space and power requirements.

More recently, chemical engineers of the technical staff of the successor company, Headley Emulsified Products Company, have developed and put into operation new types of continuously operating machines effecting appreciable economies in production, due to increased output and decreased power and floor space requirements. The new machines have a capacity of 4,000 gal. per hour, or 36,000 gal. per nine-hour day. The power requirements have been reduced to 15 hp. and floor space required by each machine is now only 30 sq.ft.

In addition to these production economies, a further remarkable and worth-while improvement has been made in the flexibility and utility of the new machines. In the original continuous machines all of the material was fully processed and only one grade of emulsion was produced at a time. In the new emulsifying mills a succession of emulsifying chambers within the main body of the machine results in successive stages of processing as the material progresses through the mill. By an ingenious tapping or withdrawing arrangement, partly processed emulsion may be withdrawn from the individual processing chambers, making it possible to produce several grades of finished products simultaneously. The ingenuity of this arrangement can well be appreciated when one considers the demand for asphalt emulsions of varying stability—such, for instance, as "fast-breaking," "medium-breaking," and "slow-breaking" — properties which are largely dependent on particle size, which in turn is largely controlled by the degree of processing or work done to emulsify any given asphalt. This chemical engineering contribution will undoubtedly prove of outstanding value to the industry as the use of emulsified asphalts continues to increase with greater acceleration from year to year.

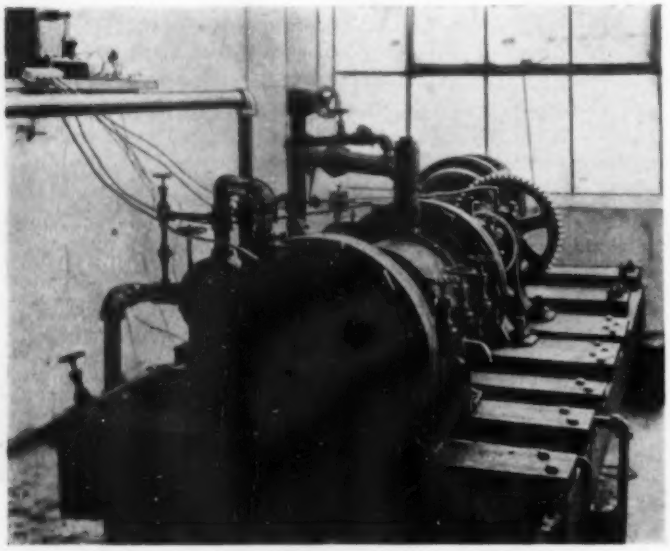
Having thus reviewed the chemical engineering developments connected with the production of emulsified asphalts in the Headley plant, it would not be amiss to return to the chemistry of these very interesting products.

EMULSIFIED asphalts consist of three mediums: asphalt, water, and emulsifier, given in the order of their preponderance. Asphalt can consist of 45 to 75 per cent by weight, water from 25 to 55 per cent, and the emulsifier or suspension medium from 1 to 10 per cent, depending on whether active emulsifiers or inert suspending mediums are used. Economical use of asphalts in emulsified form necessitates consideration of grades containing maximum asphalt content; i.e., 65-75 per cent by weight. Such considerations result in the use of minimum volumes, thus reducing application costs, and

also reduce transportation costs, both because of smaller volume and elimination of excessive water content.

Chemical and physical properties of asphalts which have been emulsified on a commercial scale vary between rather wide limits, but in general the soft and medium grades are used; i.e., asphalts whose softening points range from 110 to 160 deg. F. and having penetrations from 25 to 250 deg. While claims have been made for processes using harder materials, such finished emulsified asphalt products have not appeared in commerce. It is quite obvious that lack of cohesive and coalescing properties in these hard asphalts militates against successful emulsification.

The source, origin, or methods of refining of the asphalts are of secondary importance, since suitable emulsions can be prepared from practically all grades of asphalts falling within the range of softening point and penetration previously mentioned. It is true, however, that the use of certain types of asphalt require changes in method of processing.



By an Ingenious Tapping Arrangement the Headley Continuous Mill Can Simultaneously Produce Several Grades of Finished Products

There appears to be an existing though undefined relationship between asphaltic properties and the mechanics of emulsification, certain asphalts offering great resistance to emulsification in colloid mills where dispersion is brought about by high speeds, whereas in slow-speed paddle mixers, high-grade emulsions can be prepared with the same asphalts. Furthermore, some types of asphalts are also refractory with respect to some of the more common emulsifying agents, but will respond to emulsification with some of the less used dispersing agents. Generally speaking, most of the commonly used grades of asphalts can be emulsified.

Impurities in the water supply are of particular interest to the manufacturer of emulsified asphalts. An accurate knowledge of the nature and quantity of substances in solution in the water is necessary, and these should be controlled, since electrolytes are intimately associated with stability of asphalt emulsions.

Of prime importance is the subject of emulsifying and dispersing agents. Organic and inorganic chemistry are involved, because of the nature of materials generally used. Physical and colloidal chemistry play an important part because of the methods of associating these materials as well as the influence upon stability of emulsions of physical phenomena associated with colloidal materials.

The two most commonly used types of emulsifying and suspending agents are soaps and colloidal clays. There is much variation in soaps as to suitability for lowering surface tension, and as a general rule, with increase in molecular weight of the fatty acid radical of the soap, the surface tension lowering effect is increased. Soaps specially prepared for emulsifying asphalts are now used that impart such high stability to the emulsion that successive freezing and thawing will not "break" the emulsion. Suspensions usually are prepared by utilizing finely divided solids which are absorbed on the surface of the asphalt particles. Colloidal clays such as bentonite are often used. In using the fine earths, however, care must be taken, since some have a tendency to reverse the emulsion in cases where they are more easily wetted by the asphalt than by the water.

In the process of manufacture of soap-type asphalt emulsions the asphalt is finely dispersed, all of the minute particles (average size as low as 1.5 microns) being individually inclosed within a soapy film (the emulsifying agent) which prevents them from coalescing or sticking together when in emulsified form. The asphalt particles are completely and uniformly dispersed and remain so until the emulsion is applied. On application the film of emulsifying solution inclosing each asphalt particle quickly "breaks," due to physicochemical changes and absorption or evaporation of water, and the asphalt particles then unite to form a uniform, continuous film of solid asphalt.

The characteristic properties of the original asphalt are in no way impaired in the manufacture of soap-type emulsified asphalts. In fact, some of the properties are materially improved by the emulsifying process; namely, decreasing of susceptibility to temperature changes and improved flow resistance under heat tests. Furthermore, these emulsions are improved by virtue of improved adhesive properties, making possible through bonding to wet or moist surfaces and improved resistance to action of water, acids, alkalis, brines, fumes, and other destructive agents.

A REVIEW of past and current literature on the subject of emulsified asphalts reveals the urgent need of unbiased information for the guidance of those who might be interested in the use of this form of asphalt. The following discussion will endeavor to call attention to various items of importance to be considered in connection with the suitability of different types of emulsified asphalts for various purposes.

Let it be understood at this point that no one type of asphalt emulsion has as yet been produced that would adequately meet all the needs, for example, in: (1) the highway and railroad fields, (2) the flooring and mastic fields, (3) the waterproofing and dampproofing fields, and (4) the protective-coating fields. Some one type as a rule has found favor for certain uses whereas some other type has proved better adapted for certain other uses.

There should be a clear mark of differentiation between the terms "bituminous emulsion" and "asphalt emulsion." The first is a general designation covering asphalts, tars, pitches, waxes, and other bituminous substances. The latter specifically designates emulsified asphalt, but is often erroneously used, particularly with reference to the expression "colored asphalt emulsions,"

which in reality are not true asphalts, but other bituminous materials which may or may not have asphalt-like properties.

Closely associated with the above item comes the confusion and misuse of the terms (1) "asphalt dispersions," (2) "asphalt suspensions," and (3) "asphalt emulsions." The first expression is inclusive and defines either "suspensions" or "emulsions," or both. "Asphalt suspensions," however, differ materially from "asphalt emulsions" in their properties and uses. In general, asphalts kept in stable dispersion form by means of mineral colloids such as clays should be designated as "asphalt suspensions" or "suspended asphalts," whereas asphalts kept in stable dispersion form by means of non-mineral colloids such as fatty-acid soaps, should be designated as "asphalt emulsions" or "emulsified asphalts." I am fully aware of the existence of so-called "double emulsions" which are mixtures of clay-type suspensions and soap-type emulsions for which no appropriate designation seems available.

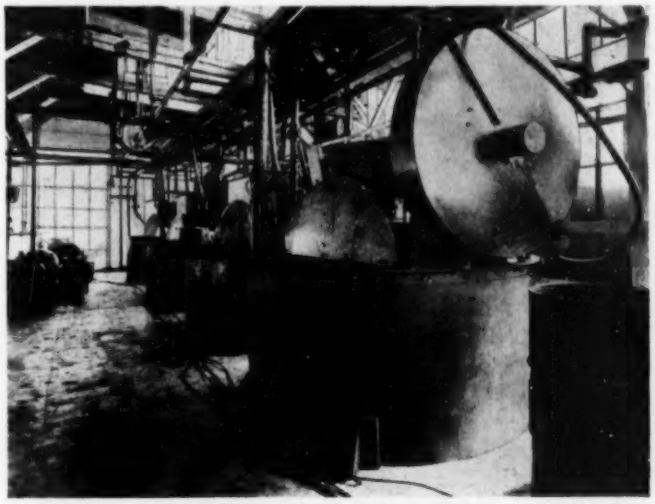
A similarly vexing situation exists with regard to the terms "stable emulsions" and "unstable emulsions." Both soap and clay types of asphalt dispersions can be termed stable, depending on the basis chosen as the measure of stability. Both types are stable toward mixing with mineral aggregate, and to my own knowledge well toward one hundred million gallons of the soap-type asphalt emulsions have been used in the highway and railroad fields, mixed with mineral aggregates for the construction and maintenance of traffic-bearing surfaces.

THE susceptibility of all true emulsions to the action of acids and other strong electrolytes is a chemical fact well known and results in flocculation or precipitation of the dispersed material. If such strong electrolytes are added to the ordinary forms of soap-type asphalt emulsions, the asphalt is precipitated in accordance with the acknowledged chemical influence of the soluble salts. Such action is of no practical significance in industrial applications and is not a criterion of quality or suitability. Portland cement cannot be added to the ordinary grades of soap-type asphalt emulsions for the preparation of cold mastics, because the asphalt is prematurely flocculated by the presence of electrolytes and unsatisfactory mastic results from the mix. However, the use of anti-electrolytes (a subject to which I referred in a paper before the Society of Chemical Industry in New York, in February, 1929) by addition to soap-type asphalt emulsions permits the admixing of portland cement, sand, asbestos fiber, and the like, to produce various mastic mixtures. It may be said, however, that the clay-suspended asphalts have proved more satisfactory for admixture with portland cement and sand for certain types of flooring purposes.

Much misapprehension exists also with regard to the manner in which different types of asphalt emulsions "break" or coalesce. Soap-type asphalt emulsions break and coalesce due to changes in physiochemical conditions brought by absorption and electrotypes on the surface being treated, and is largely independent of outer surface evaporation of water. Consequently, soap-type asphalt emulsions coalesce from the bottom outwardly, expelling water and soap solution to the outer surface, whence the water is removed by evaporation. If, however, soap-type asphalt emulsions are applied in highly excessive quantities, contrary to approved practice, coalescing takes place at the outer surface, due to loss of water by evaporation, before coalescence from bottom outwardly has been completed. In such cases there remains an inner layer of unbroken emulsions, sealed in between inner and outer coat of coalesced asphalt, which is objectionable.

On the other hand, mineral-suspended asphalts depend almost entirely on loss of water by evaporation before coalescence takes place. Since evaporation is greatest at outer exposed surfaces of the film, the tendency toward coalescence will be greater at the outer surface. Under such conditions all of the water content may be drawn to the surface by capillary force with accompanying final coalescing, or if the rate of surface evaporation is extremely rapid, coalescence will take place at the outer face and sealing of the surface will take place before the inner portion of thick film has finally coalesced. Subsequent exposure to high temperature may result in extreme porosity, due to expulsion of water through the coalesced outer skin.

Since coalescence depends in large measure on high stability and low susceptibility, the use of minimum quantities of emulsifying or suspending agents is to be preferred. Stability is largely affected by particle size, and proper control of particle size through processing is an aid in producing so-called fast, medium, and slow-breaking emulsions. Stability is furthermore affected by the nature of the emulsifying agent, particularly stability after application such as imperviousness to water, and the like. Some difference of opinion exists as to the effect on imperviousness caused by the presence of some of the inert ingredients particularly of the mineral type.



Right—Top Sections of Paddle Mixers Formerly Used in Batch Method. A Battery of Three Occupy 300 Sq.Ft. and Have a Daily Capacity of 32,400 Gal. Left—Two Headley Continuous Operating Machines. Each Occupies 30 Sq.Ft. and Has a Daily Capacity of 36,000 Gal.

IT IS fully appreciated and acknowledged that developments are taking place at a rapid rate in the production and use of emulsified asphalts. What seems new and novel this month may prove old and obsolete next month. Whatever the change may be it is now quite evident that the chemist's efforts will be largely augmented by chemical engineering improvements in methods of production. Engineers in general, fully appreciating the extreme utility and practical applications of asphalts in emulsified form, will find new uses which have thus far eluded discovery. Technology therefore adds another achievement of far-reaching effect and humanitarian utility to its ever-increasing list.

Exemplary Adaptation Of Aluminum To Construction

By JUNIUS D. EDWARDS

Assistant Director of Research, Aluminum Company of America

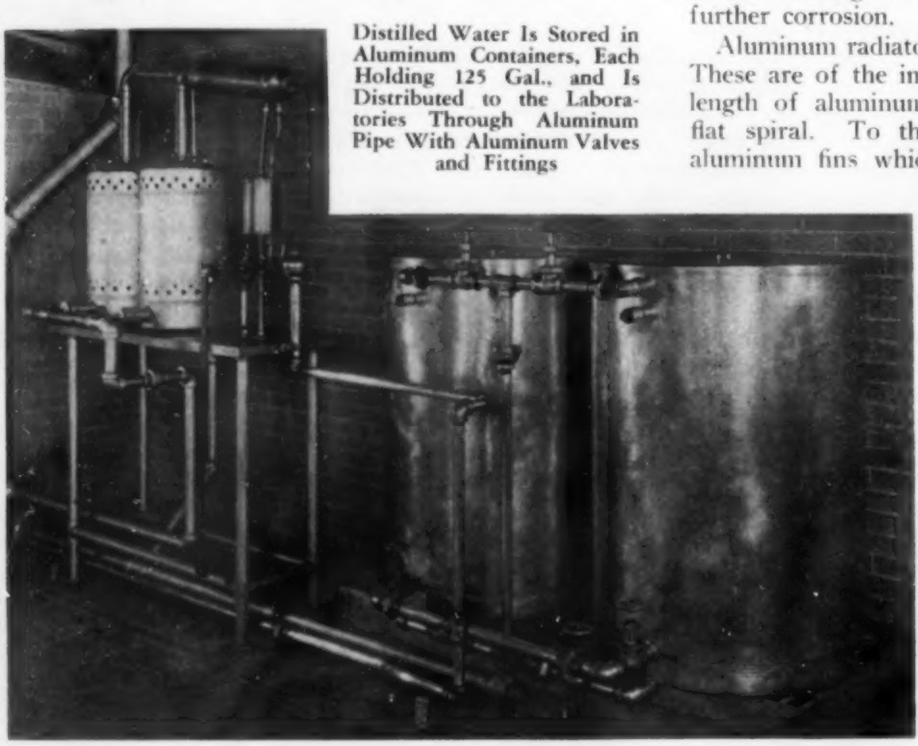
A GENERAL PICTURE of the Aluminum Research Laboratories' new home at New Kensington, Pa., was presented in an article by R. S. McBride in the preceding issue of *Chem. & Met.,* where emphasis was placed on structure layout and facilities, especially from the standpoint of chemical engineering research. Since it was the endeavor of the designers to illustrate the versatility of aluminum for plant and laboratory construction by practical working example, the laboratories also represent the adaptation of a material to a tasking variety of needs.

Passing from the building's exterior of aluminum decoration and structural accessories to the working facilities within, one observes that door hardware of aluminum—locks, door knobs, escutcheon plates, hinges, door checks—are finished in an oxide gray which does not blacken or discolor with handling, and would be considered attractive in any building or home. Lighting fixtures, electrical outlets, and many other details also are made of aluminum, as are the chairs used throughout the offices and laboratories. Aside from their lightness and comfort, they offer the advantage of being fireproof and durable. Many of them are finished in the natural aluminum color, others with a baked aluminum enamel in line with the predominant color scheme of the building.

Of major interest to the chemical industries is the extensive use which has been made of aluminum and its alloys in the chemical laboratories. Here the problem existed of finding materials which are fireproof, readily fabricated, and of satisfactory resistance to corrosion by the fumes which inevitably accompany chemical laboratories. The laboratories are equipped with chemical benches made of aluminum sheet, fabricated by a concern having considerable experience in steel furniture and similar in design to the benches which it formerly made of steel. Their lightness has no marked advantage except in the case of the drawers, which can be handled with noticeable ease as compared with steel drawers of similar construction. More important is the fact that they will not become unsightly from rust accumulations as does steel when paint or enamel fails to protect.

The hot and cold water supply for the building is handled in aluminum pipe, selected for this service only after very careful and extended tests in comparison with competitive materials for use with the particular water supply which is to be handled. There are certain other types of water supplies which aluminum can not satisfactorily handle, but in these laboratories aluminum pipe is giving excellent service.

Of special interest is the use of aluminum for the storage and distribution of distilled water. This installation was made after some 12 years of previous satisfactory experience. A very careful quantitative examination of the distilled water supply handled in this system indicates contamination by aluminum to the amount of only about one part in 100 million. This is an amount which requires extremely delicate technique to detect and estimate. Other chemical laboratories have made similar use of aluminum pipe, and with uniformly satisfactory results. Where chemical industry has the problem of storing and distributing distilled water, or water which must be kept free from iron or other metals, aluminum pipe and equipment should be the answer. The pipe is assembled like ordinary wrought-iron pipe except that a mixture of red lead and graphite is used on the threads and the fittings are all aluminum. When the pipe is filled with water it quickly forms an adherent and protective coating of aluminum oxide, which prevents further corrosion.

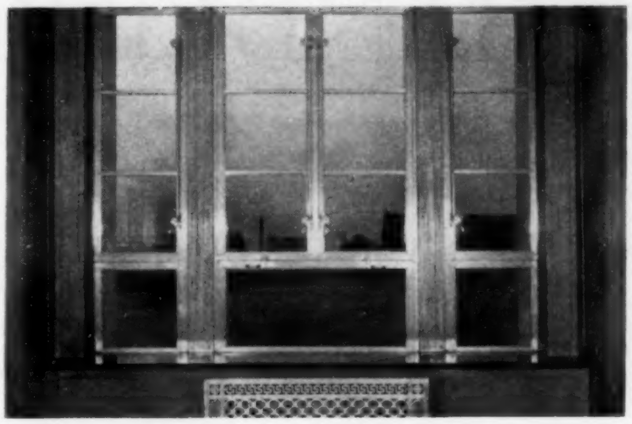


Distilled Water Is Stored in Aluminum Containers, Each Holding 125 Gal., and Is Distributed to the Laboratories Through Aluminum Pipe With Aluminum Valves and Fittings

Aluminum radiators are used in the laboratory offices. These are of the indirect heating type and consist of a length of aluminum tubing bent back and forth in a flat spiral. To this steam coil are tightly attached aluminum fins which help to transfer heat to the air rising through the vertical, chimney-like openings formed by the fins. These radiators are particularly efficient. Since their small heat capacity permits them to come up to temperature rapidly, warm air comes off the radiator in a relatively short interval after the steam is turned on. This also permits rapid regulation.

That steam can be safely handled in aluminum is illustrated by these radiators. The chemical industry at large has taken advantage of this fact in the employment of steam-jacketed kettles. These have not only been adopted by many of the food-packing industries but are also used for many industrial chemical operations

where the product is such that it can be safely handled in aluminum. Aside from their thermal efficiency, steam - jacketed aluminum kettles, as well as such other aluminum equipment as evaporating and drying trays, have the advantage that any slight solution of the aluminum which may occur, yields compounds which will not discolor the product. Hence the use of aluminum generally in the chemical industry does not depend only on its properties of lightness and good corrosion resistance.



While aluminum is not particularly resistant to attack by alkalis (with the exception of ammonia, which forms a protective coating), it shows conspicuous resistance to certain acids. For example, concentrated nitric acid has been satisfactorily handled in aluminum tanks and drums. Acetic acid also is safely stored and handled in aluminum equipment.

Due to the resistance of aluminum to attack by sulphur and hydrogen sulphide, rubber compounds can be vulcanized in contact with it without discoloration of the rubber or undesirable adhesion; a large use has therefore been developed for aluminum molds for rubber goods and for other equipment in the rubber industry. Corrosion of metals by hydrogen sulphide is becoming an increasingly pressing problem in the oil industry too. Here again experimental installations of aluminum have shown such satisfactory resistance to attack that further commercial use seems justified.

Attention may be called in passing to the effective way in which aluminum paint has been used in certain of the laboratories. For example, in the chemical-development laboratory aluminum paint has been applied over steel, plaster, concrete, and wood with equal effectiveness. Not only does it provide durable protection against any corrosive fumes which may be generated in the laboratory but its high reflectivity also adds greatly to the lighting efficiency. Because of its high opacity and hiding power, effective covering is secured with one or two coats. Where steel has been used side by side with aluminum, a coat of aluminum paint makes the steel harmonize with the aluminum.

In the minor equipment of the laboratories, aluminum has been used in many interesting ways. For example, the Dutch ovens and hot-plates with which most of the hoods are equipped are made entirely of aluminum; such aluminum hot-plate has high thermal conductivity, which gives uniform and rapid heating. Although the surface will oxidize, the oxide coating which is formed is adherent and protective in character, so that one is not troubled by scaling. The oxide film on aluminum does not progressively thicken with continued heating but seems to be quite impervious to oxygen after a certain thickness is reached. It is this property of the metal which greatly widens its industrial possibilities.

The use of aluminum has been extended to the chairs, tables, and laboratory furniture which the chemists are furnished. Even the analytical balances are equipped with cast aluminum cases. This is another instance where a manufacturer has employed aluminum at the request of the laboratories and has been so impressed with its advantages that he has adopted it for his regular production. The balance maker in question was one of the first users of aluminum in this country. He imported several ounces of this metal in 1885, at $14 per ounce, for the purpose of making fractional weights and riders. He was one of the pioneers in the use of aluminum balance beams and is now the first manufacturer to adopt the all-aluminum case for balances.

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Wetting Agents for Sprays

IN the spray method of effecting thorough contact of liquids with surfaces to be treated—for instance, in the application of insecticides and fungicides to trees or growing crops—certain agents are needed to impart to the liquid the properties needed for efficient spraying. These are called wetters or spreaders, but according to R. M. Wood in *Jour. Soc. Chem. Ind.,* they may have one or more of several functions. A spray will not spread over a surface as a film unless it wets the surface; but it may have wetting properties and yet not spread; that is, each impinging drop may remain as a lens on the wetted surface. In some cases, wetting agents are also effective as emulsifiers and hence are useful in oil-in-water sprays. Again they may act as protective colloids to help maintain solid ingredients in colloidal suspension; glue, caseinates and soaps are helpful in this way. Similarly they aid in holding in solution formaldehyde, hydrocarbons or other organic ingredients of the spray.

Some wetting agents are chosen because they are also water-softeners, or because they nullify the harmful effect of the salts in hard water on the properties of the spray. In other cases, the wetter or spreader may serve also as an aid to the adhesion of the film left by the spray, especially its resistance to removal by rain or wind. Gelatine is one of the agents useful for this purpose. Three tensions are involved in the wetting of a solid by a liquid, namely, solid : liquid, solid : air and liquid : air. The last of these, commonly known as surface tension, is the only one readily susceptible to measurement.

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Sugar Acids From Xylose

CONVERSION of xylose to the corresponding monobasic and dibasic organic acids by oxidation constitutes a possible use for this now readily available sugar, according to a recent statement of the Bureau of Standards. A study of the oxidation of xylose with nitric acid indicates that the best production of the sugar acids takes place with the least loss of nitric acid when the molar ratio of sugar to nitric acid is kept close to 1 : 2 which is also the theoretical ratio for the reaction, and when the period of oxidation is kept to a minimum.

FLUIDS HANDLING—II

By W. L. BADGER
and
W. L. McCABE

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The second of three articles on the transportation of liquids and gases. Although written primarily for the younger engineer, these articles contain much that can profitably be reviewed by the experienced engineer.

Editor's Note—Through an error in the first article of this series, which appeared in June, one of the authors was named as Prof. E. M. Baker, whereas Professor Badger's co-author actually is W. L. McCabe. The editors take this opportunity to correct a very regrettable misimpression.

IN THE FIRST article of this series, types of equipment for the conveying of fluids were described with particular reference to pipe, fittings and valves. In this issue and in the third and last article of the series, to appear in August, the principal methods of producing flow of fluids will be discussed. The present article deals with the moving of fluids by means of ejectors, acid eggs, air lifts, and reciprocating pumps. The last article will take up rotary and centrifugal pumps for liquids; and fans, blowers and compressors for gases.

Much has been written in *Chem. & Met.* within the last year (**36**, 1929, pp. 522 to 576; **36**, 1929, supplement to September issue; **36**, 1929, pp. 747 to 750) in regard to special materials of construction for resistance to corrosion. It will not, therefore, be necessary to discuss here at any considerable length special materials for fluids-handling equipment. A few statements concerning the more common special materials will suffice for this article.

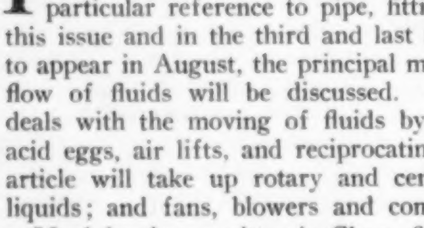


Fig. 1—Semi-Automatic Acid Egg With Manual Control of Air

There is no one satisfactory corrosion-resisting material for all purposes. Most materials have serious disadvantages. For the construction of fluids-handling equipment, aside from the great mass of such apparatus which is made from cast iron, wrought iron, or steel, a number of special materials have particular significance.

Acidproof stoneware is highly resistant to acids but has the disadvantages of heavy weight and high coefficient of expansion. Care must be taken to prevent breakage due to temperature changes. Bell-and-spigot as well as special joints are used for pipe. Glass, on the other hand, is stronger and lighter and much more resistant to thermal changes. In the small number of forms in which it is now available, it cannot yet be considered a general material. The third material, Duriron, a high-silicon iron, suffers also from high thermal expansion. It is very hard and brittle and easily broken. It can be ground but not machined. It is, however, exceedingly resistant to acids and available in a variety of shapes and sizes.

Lead is much used because of its resistance, especially to solutions containing sulphuric acid, and because of the wide variety of weights and diameters in which it may be obtained. By use of autogenous welding (lead burning) the metal may be fabricated into almost any sort of equipment. The principal disadvantage of lead is its very low elastic limit, which permits "crawling" and deformation. To avoid this, lead is often bonded to the inner surfaces of iron equipment or in piping, using a layer of tin, which alloys with both metals. Or equipment may be lined with rubber, which is vulcanized very satisfactorily to the steel, yielding excellent resistance.

Copper and brass, especially the former, are frequently used. Copper is resistant to practically all acids except nitric, as long as oxidation is avoided. Brass is not especially resistant and is used principally in small brass valves.

Of the copper-base alloys, some are quite complex, containing four or five constituents, and some are highly resistant. The iron-base materials usually are alloyed with chromium, nickel, or both; and are in most cases highly resistant, as well as available in most forms. Monel metal, a nickel-base alloy, containing about 60 per cent nickel, 30 per cent copper, and the remainder, minor ingredients, is much used because of its strength, ready workability, and considerable resistance to dilute solutions. It is not easily available in the form of pipe. Pure nickel, obtainable in tubing as well as sheets and bars, has become available recently at a reasonable price and its uses are expanding rapidly.

With this background, it is now desirable to go on to pumps, which will in most cases be taken up without reference to special materials.

A large number of pumps, differing widely in principle and mechanical construction, have been developed

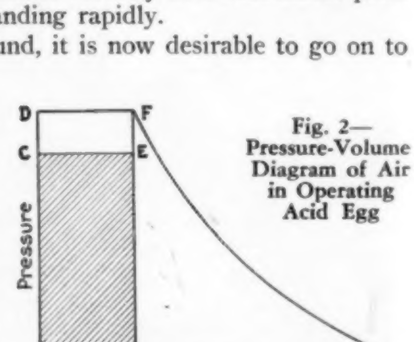


Fig. 2—Pressure-Volume Diagram of Air in Operating Acid Egg

This is the second of three articles which will later appear at greater length as one chapter of a book by the authors, to be published as part of the Chemical Engineering Series by the McGraw-Hill Book Company, under the title of "Elements of Chemical Engineering."

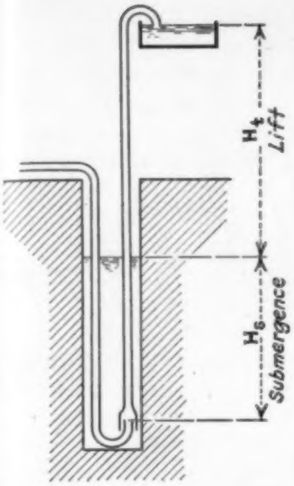


Fig. 3 — Air Lift Shown Diagrammatically With Submergence and Lift

to meet a wide variety of operating conditions. No one pump or class of pumps can be considered to be of prime importance with respect to the rest. All the pumps to be described are good practice under suitable conditions at the present time. No really systematic classification of all types of pumps is possible.

Acid Egg — Possibly the simplest method of moving a fluid is to displace it from a container by means of air. Apparatus of this type has long been standard in transferring sulphuric acid, and due to this application such apparatus usually is called an acid egg. It also is called a blow-case or montejus. A simple form consists essentially of a container which can be charged with a batch of fluid to be moved, an outlet pipe leading from the bottom of the container, an inlet pipe, and a pipe through which compressed air can be admitted. The action of such an apparatus is obvious.

A semi-automatic acid egg is shown in Fig. 1. A check valve is placed in the inlet line, and the air line is reduced to $\frac{1}{2}$- or $\frac{3}{4}$-in. pipe. The air control valve is located at any convenient point, and may be some distance from the egg. A gage is placed in the air line near the air control valve, and between it and the egg. When air is turned on, the gage shows a pressure, due to the column of acid in the discharge pipe. The cross-section of the acid outlet is sufficiently larger than that of the air inlet line so that when the egg empties the air pressure falls and the operator notices this on the gage.

More complicated forms of this apparatus are available which will automatically turn the air on and off as required, and such acid eggs require no attention during their operation. With the development of centrifugal pumps made of acid-resisting materials, the necessity for the acid egg is gradually passing. Its principal disadvantage is not only that it is usually manually operated and intermittent in its action but it is wasteful of power, because at the end of the cycle the entire egg is filled with air at the discharge pressure, and this is all lost as soon as the discharge pipe empties. The acid egg cannot make use of the work which could be done by the air in expanding from the pressure of the egg to atmospheric.

Fig. 4—Two Types of Foot Piece for Air Lifts

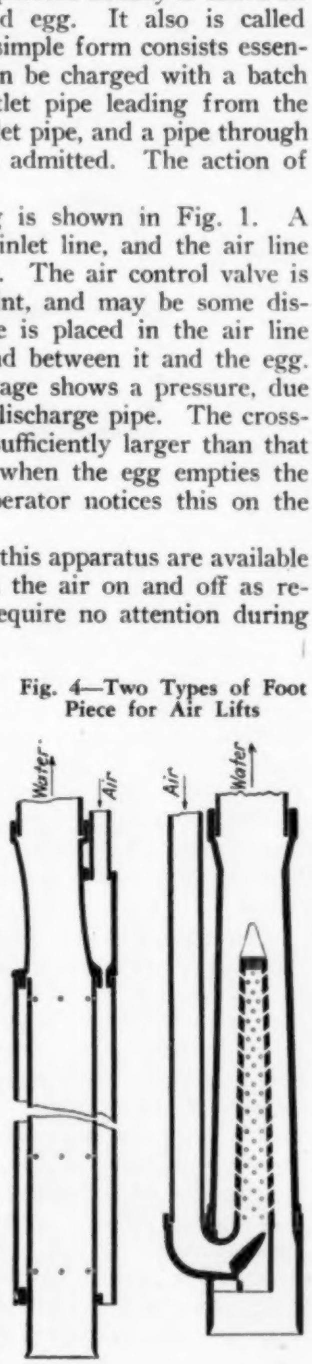


Fig. 2 shows diagrammatically the operation of an acid egg. Volumes are plotted along the horizontal axis and pressures are plotted along the vertical axis. *AB* is the volume of the acid egg; *AC* is the pressure equivalent of the column of liquid which must be raised. In practice the pressure of the air must be greater than *AC*, because of frictional losses in the line, so that the actual pressure which must be employed is *AD*. In order to move the volume of the egg through the pressure range, *AC*, a total amount of work represented in the diagram by *ACEB* would be necessary. Actually, it is necessary in the first place to compress sufficient air to fill the egg, not to the pressure *AC* but to the pressure *AD*. Further, this air, after its discharge from the egg, could do work by expanding along the line *FG*, and this work, of course, must be done in compressing the air. Consequently, the maximum theoretical efficiency of the acid egg is represented by the ratio of the area *ACEB* to the area *ADFG*.

This efficiency must also be multiplied by the efficiency of the air compressor. If the volumetric efficiency of the egg is 40 per cent, which probably is the maximum that could be reached, and the efficiency of the compressor is 60 per cent, the over-all efficiency of compressor and egg is only 0.40x0.60, or 24 per cent. This would represent perfect working of the egg and would mean that the air would be shut off at the instant that the egg became empty. If this is not the case and air is allowed to blow through the discharge pipe, as usually will happen in practice, the efficiency of the egg may easily drop to a fraction of a per cent. When this is compared with efficiencies of 12 to 15 per cent, which can be obtained with the simplest and cheapest centrifugal pumps, it appears that the acid egg is an uneconomical method of transporting liquids and should never be used when any other device is available.

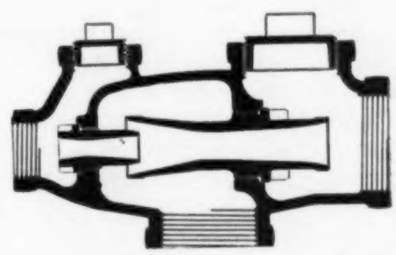


Fig. 5—Simple Ejector for Moving Fluids Against Low Heads

Air Lift—A more efficient use of compressed air as a fluid transporting agent is represented by the air lift. Fig. 3 shows an air lift. In this apparatus the discharge pipe is immersed in the liquid to be pumped, and a jet of compressed air is admitted into the discharge pipe at the submerged end. The pressure and velocity heads of the air released at this point carry the air and slugs of liquid up through the pipe to the discharge end. The manner in which the air is distributed at the bottom of the air lift has a considerable effect on the performance of the apparatus. Fig. 4 shows two types of foot-piece.

Although the mechanical construction of the air lift is simple, its action is so complicated that no adequate mathematical theory has ever been developed. Such a theory would involve the frictional resistance of bubbles of air rising through a column of water, and is beyond the present state of our knowledge. An empirical formula (Ingersoll-Rand Company) which has been developed from practice is:

$$V_a = 0.8 \frac{H_t}{C \log \dfrac{H_s + 34}{34}}$$

in which V_a is the volume of free air required to lift 1 gal. of water; H_t is total lift, or the total distance from the working surface of the water to the point of discharge; H_s is running submergence, or the distance from

the water level to the point of air inlet; and C is a constant to be taken from the following table:

Lift in Feet, H_l	Constant, C
10 to 60	245
61 to 200	233
201 to 500	216
501 to 650	185
651 to 750	156

The submergence, expressed as the ratio, $\frac{H_s}{H_s + H_l}$ should vary from 0.66 for a lift of 20 ft. to 0.41 for a lift of 500 ft. This formula is said to approximate average practice, but a wide variation in results can be obtained by varying the design of foot-pieces.

This method of lifting a fluid has an advantage over the acid egg in that the air is utilized at a constant efficiency, due to continuous operation. Another prime advantage of this apparatus is the complete absence of moving parts and its extreme simplicity. On the other hand, the air lift requires a great deal of compressed air and the over-all mechanical efficiency of air compressor and lift is low, though higher than in the acid egg. Mechanical efficiency of 30 per cent probably is as high as usually is obtained. Another primary disadvantage is the submergence required.

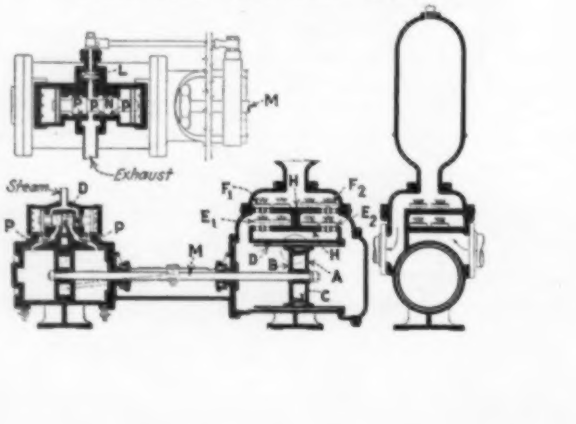
Ejectors—Another common method of moving a fluid without using moving parts is by means of an ejector. One type is shown in Fig. 5. The essential feature of the ejector is the expansion of a fluid through a nozzle, the discharge of which is in contact with the fluid to be moved. As the first fluid issues from the nozzle, its velocity head is increased, with a corresponding decrease in its pressure head. If this pressure head is less than that of the second fluid at that point, the second fluid will be sucked into the ejector. The simple ejector has the disadvantages of being able to develop only a small head, of being mechanically inefficient, and of diluting the material as it is being transferred. Operated by steam, it is used for transferring liquids from one tank to another, and in similar cases where the head is low. It is also used to move gases at low heads, and very efficient types have been developed for use as vacuum pumps.

Ejectors have, however, been developed from the simple type to a point where they are so efficient mechanically that they can pump fluid into a space under the same pressure as is present on the actuating fluid. In this form the device is called an *injector*. The best example of this type of injector is that used for feeding boilers.

Reciprocating Pumps

In the past, by far the most important method of moving fluids was by the use of some form of reciprocating pump. Such pumps are still of very great importance,

Fig. 6—Simplex Double-Acting Steam-Driven Piston Pump With Deck Valves



although they have found a formidable competitor in the more recently developed rotary pumps of various types.

From the standpoint of motive power, reciprocating pumps are classified as steam pumps or power pumps. They may be classified also as simplex, duplex, triplex, etc., according to the number of water cylinders operated on a single drive mechanism.

Piston Pumps—Fig. 6 shows a simplex double-acting steam-driven deck-valve piston pump. This pump is suitable for heads up to 150 to 200 ft., and for any liquids which are not especially viscous, corrosive, or abrasive. The piston consists essentially of two disks, *A*, and, *B*, with rings of packing, *C*, between them, so arranged that the outer of these disks can be drawn up to compress the packing. The piston may operate in a cylinder bored directly in the pump casting, but in the better pumps the piston operates in a removable bronze liner, *D*. The lower row of valves, *E*, are suction valves;

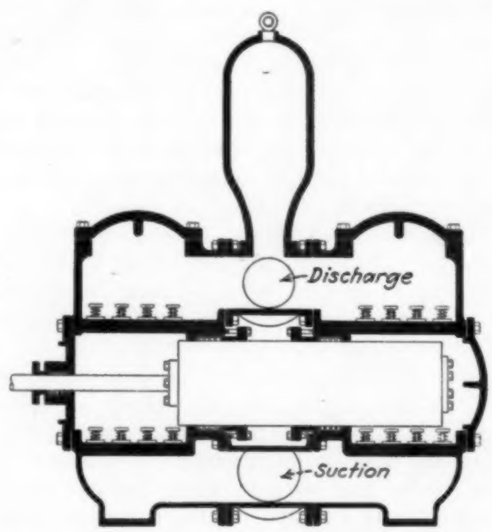


Fig. 7—Water End of Outside-Center-Packed Plunger Pump With Multiple Deck Valves

the upper row, *F*, are discharge valves. If the piston is moving from left to right, it is obvious that it will create a suction on the left-hand side which will open the left-hand suction valves, E_1, and close the left-hand discharge valves, F_1. At the same time a pressure is developed on the right-hand side which will hold closed the right-hand suction valves, E_2, and open the right-hand discharge valves, F_2. This pump is double acting, in that it displaces water on both halves of the stroke, and it will be seen that such a pump requires a minimum of four valves.

The construction of these valves is not detailed in the illustration but is easily described. A bronze valve seat is pressed or threaded into the valve deck of the pump, and carries a spider supporting the central boss. Into this boss is fastened a stem which carries the spring that holds the valve disk against the valve seat. The disk may be of hard rubber composition or of metal, the former being the more common. Such valves cannot be made larger than 5 or 6 in. in diameter. In larger valves the total pressure would be too great for a rubber disk to withstand; at the same time, increasing the contact area between valve disk and valve seat would increase the chance of imperfect seating at some point. Consequently, if the pump is to discharge during one-half stroke more water than can be passed through such a valve at reasonable velocities, several valves will be used. Conse-

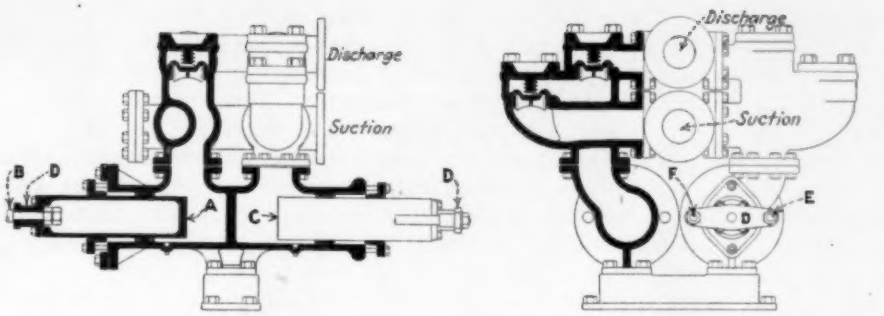


Fig. 8—End and Side Elevations, Partly in Section, of Water End of Outside-End-Packed Plunger Pump With Pot Valves

quently, instead of the minimum of four valves there will often be a multiple of four, as shown in Fig. 6.

The steam-end construction is subject to considerable modification in different reciprocating pumps, but such differences will not be considered here. In general it can be said that the steam end of reciprocating pumps varies from that of the steam reciprocating engine, in that the steam is not used expansively but is used under full pressure for the entire stroke. This is necessary because a constant pressure must be maintained on the water end, in order that the pump discharge shall remain uniform. Consequently, the steam valve gear must be so designed that the steam ports open fully at the beginning of the stroke and remain fully open to the end of the stroke. This usually involves a double valve mechanism. In the pump shown in Fig. 6, a pilot valve, *L,* operated by the piston rod, *M,* trips the main valve, *N,* which moves to uncover completely the ports, *P.*

Plunger Pumps—A plunger is differentiated from a piston in that a plunger moves past stationary packing, whereas a piston carries its packing with it. As such pumps as are shown in Fig. 6 become larger, the difficulty of replacing the packing increases. When pumping liquids containing suspended matter that is likely to cut the packing, so that replacements are more frequent, it is desirable to have packing more accessible. This has led to the development of the outside-center-packed pump shown in Fig. 7. In this case the pump casting is split in the middle and, instead of a piston carrying its own packing, there are two stationary stuffing boxes with a plunger moving through them. This places the packing on the outside of the pump, where it is easy to see leaks and easy to make repairs when they become necessary.

The same drawing also shows how the area of the sheet of cast iron carrying the valves increases as the size of the pump is increased. It is obvious that such a pump would not be suitable for high pressures, because the large flat unstayed valve decks of cast iron must, at each half stroke of the pump, carry the full difference between suction and discharge pressures. This pressure distributed over such a large area cannot be carried by a material which is as weak in bending as is cast iron. Consequently, for pumps to operate against higher pressures, a different design of valve, called the pot valve is employed.

Outside-End-Packed Pumps—Fig. 8 shows two views of the water end of a duplex outside-end-packed plunger pump with pot valves. In this case the water cylinder is divided into two parts by a partition and the plunger also is in two parts. The left-hand half, *A,* of the plunger is directly connected to the piston rod, *B,* and the right-hand half, *C,* of the plunger is operated from the other end by means of a yoke, *D,* and tie-rods, *E.* In this case the stuffing boxes that contain the packing are much easier of access than in the outside-center-packed type. Consequently, this type of pump is suitable for higher pressures, because the packing may be more easily maintained. Higher pressures, however, preclude the use of deck valves. Consequently, this pump has pot valves. Their construction is obvious from the drawing, and it is merely necessary to call attention to the fact that since each valve is in a separate cylindrical casting, these castings may be made as heavy as desired and can, therefore, stand any pressure which it may be necessary to impose on them.

Since pot valves are required only where high pressures are employed, it is obvious that a rubber composition disk is hardly suitable. Consequently, pot valves usually have metal disks which are often provided with guide vanes to keep them in alignment, as shown in Fig. 8. For exceedingly high pressures or viscous liquids, even the metal disk may not be strong enough, and in such cases a loose metal ball is used in place of the valve disk.

Duplex Pumps—It will be noticed that the pump shown in Fig. 8 has two water cylinders and was called a duplex pump. This particular classification is important enough to warrant special mention. The pump shown in Fig. 6 is a simplex pump, since it has one water and one steam cylinder. The duplex pump can be considered to be two simplex pumps mounted side by side on the same frame with each pump actuating the steam valve of the other. The steam cylinders are bored separately in one casting, the water cylinders in another, and the two are connected by the yoke. Both steam valves are in a common valve chamber above the steam end casting.

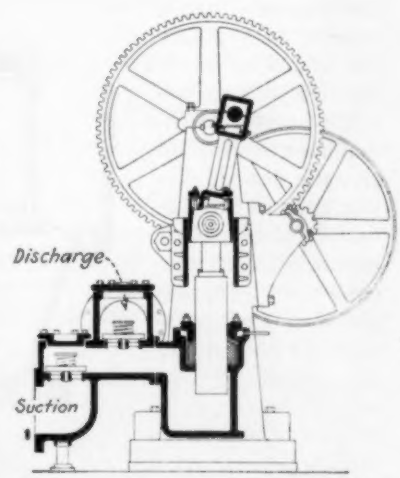


Fig. 9—Vertical Single-Acting Triplex Power Pump

Power Pumps — Reciprocating pumps are most often thought of as having the water cylinder and the steam cylinder on opposite ends of the same piston rod, and therefore driven by direct steam pressure. This is not necessary, since it is obvious that any form of power may be utilized to drive the piston rod. The general name power pumps is given to all forms of reciprocating pumps in which the piston is actuated by some other force than direct steam pressure. This usually involves connecting the piston to a crankshaft which is rotated, usually through reduction gears, by a belt from a line shaft, an electric motor, or any other convenient form of power.

If the piston is to be operated from a crankshaft, any number of water cylinders may be connected in parallel

and their pistons located at different points on the shaft. This has the advantage of making the discharge of the pump more uniform and free from pulsations, and it also means that if there are several cylinders in parallel, each cylinder can be smaller, and therefore easier to build for high pressures and easier to keep packed properly.

A very common form of this type of pump is the vertical single-acting triplex power pump (Fig. 9). Three cylinders with their suction and discharge valves as shown in this section are arranged side by side, and their pistons connected at points 120 deg. apart on the crankshaft. Such a pump as shown is single-acting. In other words, it discharges only on the downstroke. Therefore, only two valves are required for each plunger. Vertical triplex pumps are not necessarily single-acting, but are very often so built.

Diaphragm Pumps—The diaphragm pump is shown in Fig. 10. It is ordinarily thought of as a very cheap pump for the crudest and most temporary service. For the chemical engineer, however, it is the most satisfactory pump available for handling liquids with large quantities of solids in suspension. It also has the advantage of permitting regulation of the rate of discharge. Instead of a piston or plunger, it employs a flexible diaphragm, *A*, with a flap discharge valve, *B*, in the center. It also has a suction valve, *C*. Since it has no moving parts except the flexible diaphragm and the valve, as its construction is rugged and simple, and repairs are easily made, it is suited for the most severe service. By operating the diaphragm from an adjustable eccentric, the stroke may be varied and the discharge controlled within accurate limits.

Reciprocating Pump Theory—In the design of reciprocating steam pumps, two points are of major interest. The first is the size of water cylinder necessary to give the desired discharge, and the second is the size of steam cylinder necessary to generate the desired pressure. Details of mechanical design are not within the province of this article, but belong rather within the field of the mechanical engineer.

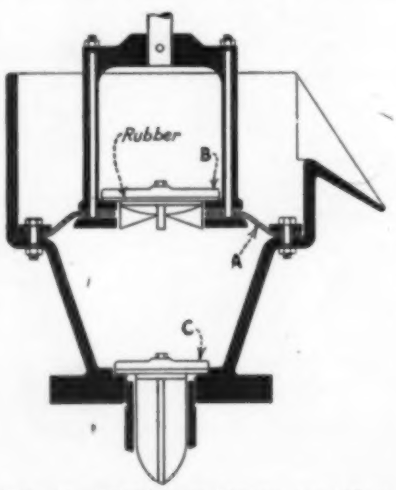


Fig. 10—Diaphragm Pumps Are Well Adapted to Handle Heavy Slurries

The theoretical displacement of the piston during one stroke obviously is the area of the piston multiplied by the length of the stroke. The number of strokes per minute should not be over 100 to 125 for pumps of less than 10-in. stroke, because higher speeds result in excessive wear on valves and valve springs. For pumps of 10-in. stroke or longer, a piston speed of 100 ft. per minute is customary. The theoretical displacement in cubic feet per minute will be the product of the piston speed in feet per minute and the area of the piston in square feet. Of course, this theoretical displacement is never reached. There are losses due to slippage past the piston from imperfect packing, due to leaky valves, and due to failure of the valves to close instantly when the piston reverses its direction of travel. All of these factors result in an actual discharge of 50 to 90 per cent of the theoretical displacement. This fraction usually is spoken of as the volumetric or water-end efficiency. The lower figure represents poorly packed pumps working at high speeds; the larger figure represents large, slow-speed pumps with the packing and valves maintained in first-class condition. A fair average for estimating purposes is perhaps 75 per cent.

The steam pressure in pounds per square inch multiplied by the area of the steam piston in square inches represents the total pressure acting on the piston rod. If the pump were a perfect machine operating without friction, this would also be the total pressure developed on the water piston. This total pressure divided by the area of the water piston in square inches would give the theoretical maximum water-end pressure in pounds per square inch. Under these conditions, however, the total pressure on the steam piston would be exactly equal to the total pressure on the water piston and therefore the pistons would be stationary. In order to do work on the liquid and to overcome pump friction, the total pressure on the steam piston must be greater than that desired on the water piston. The ratio of the theoretical pressure on the steam piston to the pressure actually needed is known as the steam-end or pressure efficiency and varies from 60 to 80 per cent.

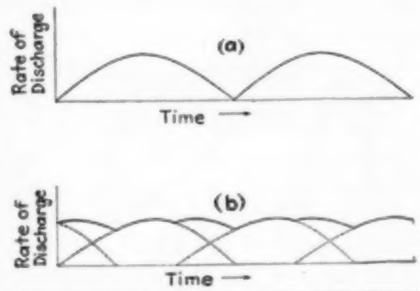


Fig. 11—Discharge Curves for Reciprocating Pumps: *(a)* Single Cylinder Double-Acting Steam Pump; *(b)* Triplex Power Pump

The rate of discharge from one end of the piston of a reciprocating pump is zero at the beginning of a stroke and rises to a maximum as the piston reaches full speed. The discharge from a single-cylinder double-acting pump would be such a curve as is shown above in Fig. 11 (*a*).

To remove pulsations in the line, with their consequent losses, the duplex pump often is recommended, since its discharge curve should theoretically be the sum of two such curves as Fig. 11 (*a*), half a stroke apart, i.e., the second starting at the peak of the first.

It is obvious that the larger the number of cylinders the smoother will this curve be. For example, the theoretical discharge from a triplex pump is indicated in Fig. 11(*b*). In pumping at high pressures the dangers of shocks and pulsations are aggravated, and it is obvious that for high pressures the triplex pump is more suitable than the single or duplex. As a matter of fact, pumps to deliver very high pressures often have five cylinders on a single crankshaft to make the discharge curve still more uniform.

It will be noted that the pumps shown in Figs. 6 and 7 have large air domes on the water end. These are to minimize the effect of such fluctuations as are indicated in Fig. 11(*a*). The air will be compressed when the water piston is accelerating, and will expand when it is decelerating. Air chambers are often installed on the suction side also, especially if it is necessary for the suction pipe to be long.

Much Arc Welding in New Liquid CO_2 Plant

By A. F. DAVIS

Vice-President, Lincoln Electric Company Cleveland, Ohio

Fig. 2—Arc Welder Sealing Joints in Absorber Tower; These Towers Are 100 Ft. High and 10 Ft. in Diameter, Constructed of Plate Varying in Thickness From ½ In. at Bottom to ¼ In. at Top; Arc Welding to Seal Riveted Joints Makes Tightness Against Gas and Solvent Leakage Certain

ARC WELDING has been used in no small degree for the fabrication of the pipe and stacks in the new plant of the Liquid Carbonic Corporation at Cleveland, Ohio, erected for the manufacture of liquid carbon dioxide. This new plant, constructed by the H. K. Ferguson Company, of Cleveland, is of brick construction. The manufacturing machinery is on the main floor and the general offices are on the second. It was so constructed that there is sufficient space for increasing the equipment so that it will more than double the capacity of the plant.

Manufacturing equipment consists of stacks, piping, absorbing towers, tanks, and the necessary driving mechanism, much of which is fabricated by arc welding. The stacks, one of which is shown in Fig. 1, are 80 ft. high and approximately 30 in. in diameter. Much of the piping, varying in size from 24 in. down, also is fabricated by arc welding, as shown in Figs. 1 and 3.

The absorbing towers, shown in Fig. 2, are fabricated by riveting and the joints sealed by arc welding. These towers are 100 ft. high and 10 ft. in diameter, and are constructed of 20 rings of steel plate, each 5 ft. in height, varying in thickness from ½ in. at the base to ¼ in. at the top. In the process of manufacture, the flue gas from burned coke rises in these towers through the packing material, as a solution of sodium carbonate trickles down, absorbing some of the gas. Arc welding of the seams in the large towers makes it possible to minimize the seepage of the solution of sodium carbonate, which is generally recognized to be a very difficult liquid to hold. Any leakage of the solution can be quickly noticed, due to the fact that the sodium carbonate leaves a light colored mark on the steel plate wherever leakage occurs. Close inspection of Fig. 3 shows leakage around one of the rivet heads, but there is no indication of leakage in the arc-welded joints. It is for this reason in particular that welding was used to seal the seams in the absorbing towers.

Arc welding has proved very valuable in the installation of equipment of this type. With an electric arc welder on the job it is possible to place the equipment and then make the best possible piping arrangement, for with this process, connections can be made at any point. This makes unnecessary the accurate laying-out of piping and equipment before installation, which often must be changed when the actual installation is made. Such changes on the job are indeed costly where the connections are of the riveted or bolted-flange type. With the use of welding the connections can be made at any point, as there are no rivet holes or bolt holes to line up, the electric arc being capable of fusing metal directly into metal at any angle.

Thus the convenience and the superior physical qualities of welded connections have made this type most desirable in the installation of equipment, especially in the process industries, where piping is often very involved and absolutely tight joints are required.

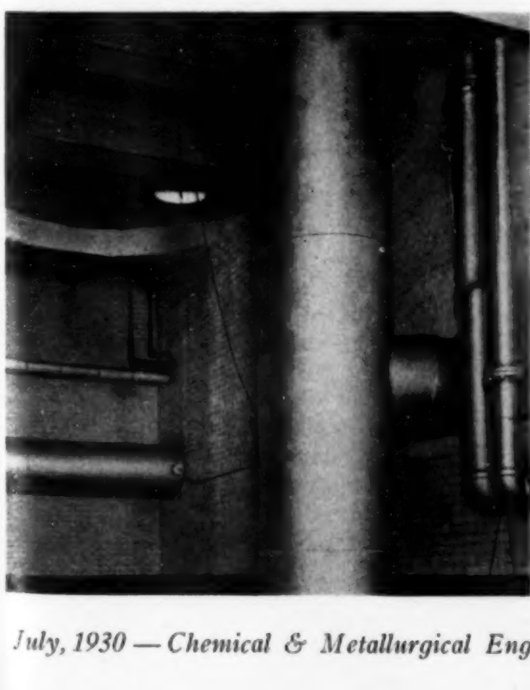
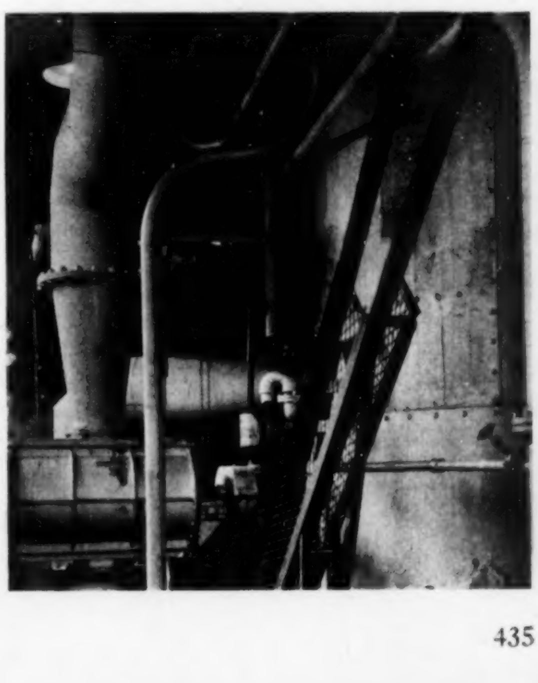


Fig. 1 — Left: Arc Welded Stack and Piping; Holes in Floor Above Are for Future Expansion

Fig. 3—Right: Draft Lines and Piping Fabricated by Arc Welding; Note Weld-Sealed Seams of Absorber Tower at Right



Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

The Quiet Glory of the Incognito

To the Editor of Chem. & Met.:

Sir:—In behalf of the future of America's chemical industry I should like to enlist your aid in persuading chemical manufacturing companies to put their names on their plants. Whether the nameless condition of most chemical factories is due to their modesty, to shamefacedness, or to a hold-over from the old days of secrecy I do not know, but I do believe that this self-effacement bodes them no good. While every other industry is impressing on the American business man who travels—by air, by automobile, or by train—who it is and what it makes, the chemical industry alone persists in hiding its light under a bushel.

If we believe with the psychologists that the most good business ideas are born on suburban trains, on motor jaunts, or when the mind is free from petty details, and not down in the pits where the wheels of industry are grinding, then it is important that we give the business travelers a good impression of our plants. True enough, only one traveler in a thousand may be a possible purchaser for our particular chemical products, but in the mind of this thousandth one may be started a train of thought that will lead to new business. It is probable that for impressing his thousandth reader the builder of America's most expensive motor cars is one of the most persistent advertisers in the country's largest 5-cent weekly.

Unfortunately, it has also been a traditional custom of chemical companies to display their names on some obscure building in letters a few inches high on a background of the same color, so that it becomes necessary for even a delivery truck driver to cross-examine the plant watchman to make sure he has come to the right place.

But, even if we grant that the publicity value of a name on a fence, or a building, or a tank may be only transitory, there remains a definite and permanent value in giving a plant a name—that of employee morale. Morale is distinctly tied up with an employee's pride. His efficiency is increased when he is proud of his employer. However, it is too much to expect an employee to become terribly enthusiastic over a plant that is unconscious of or ashamed of its identity. Many large chemical plants, forming perhaps a considerable proportion of the total industry of their cities, are virtually unknown to the citizens, because they refrain from even the most modest announcement of their presence. And the employee comes to think that his company is not so hot after all.

Recently my 12-year old nephew, who had made an automobile trip with his parents from Atlanta to New York City, sent me his log book, which showed each city, river, battlefield, and factory along the way. In vain did I search for the name of a chemical plant. Not one was to be found—mines, coal washeries, refineries, shipyards, rolling mills, and power plants had a complete monopoly. This young man is already looking forward to an engineering career, but, unless he becomes a reader of chemical journals, he probably will get through college without even suspecting that there is such a thing as an American chemical industry.

Seriously, if our industry is to attract the brains, capital, and patronage that are vital to its progress, isn't it about time we came out of our holes to tell the world by means of signs on our premises who we are and what we make? If our particular plant looks so like the very devil that we blush to name it, then the cleaning and the painting up of the factory can go hand in hand with the new sign.

Leaving the signs with myriads of electric lights and miles of neon tubing to the shaving cream, the soft drink, and the tobacco industries, why should the daddy of them all begrudge a gallon or two of bright paint to put his name on the fence so that the eternally fact-hungry mind of the traveler can be satisfied?

When all our plants are tagged properly the following remarks of a director of a chemical company to his fellow board members may not be entirely imaginary: "I never realized until the other day when I came down the Mohawk Valley and saw within a few miles of one another five big plants that can take care of all our raw material requirements, that there is the ideal site for our new factory."

Fred D. Hartford.

Chief Engineer,
Burkhardt & Sons Steel Co. Iron Works,
Denver, Col.

Container Drums Raise a Quandary

To the Editor of Chem. & Met.:

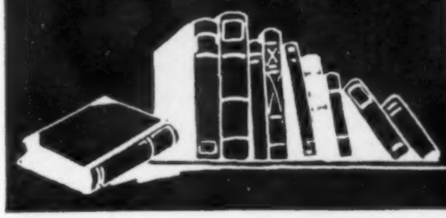
Sir:—Every chemical factory receives and ships goods in drums. The disposition of the used drums, especially when they have become rusty or leakers, is a serious problem for every chemical plant, as they cannot be sold as junk. The drum dump of every chemical enterprise is not only an eyesore hated by every neighbor but also constitutes a potential source of fire and explosion, especially in hot weather.

Perhaps some of your readers have found a way of quickly and cheaply disposing of the drums which have become useless, or have found some apparatus which will flatten out or otherwise dispose of drums so that they can be sold as junk. A helpful solution would be generally welcomed.

M. Szamatolski.

Givaudan-Delawanna, Inc.,
Delawanna, N. J.

CHEMICAL ENGINEER'S BOOKSHELF



The Latex Industry

LATEX, Its Occurrence, Collection, Properties and Technical Applications. By *Ernst A. Hauser*. Translated by *W. J. Kelly*. The Chemical Catalog Company, Inc., New York, 1930. 201 pages. Price, $4.

Reviewed by JAMES A. LEE

RUBBER technologists are fortunate that Dr. Hauser, one of the outstanding authorities in the world, has compiled the available information and data on latex. This volume includes a historical introduction, and discussions of the collection of latex, its chemical and physical properties, the non-rubber constituents, and less important latices. The science of coagulation, preparation of "Whole Latex Rubber," preparation and shipment of latex are discussed at length by the author. The chapter on the industrial applications of latex is of particular merit. Among the applications discussed are the impregnation of fabrics and cords, the manufacture of spread and dipped goods, and the application of latex in other industries.

Interest in this volume is not confined to the rubber technologist, for the discussion of the methods which are used for the spraying of latex should be of interest to chemical engineers that have problems in the evaporation of solutions. The spray processes for the complete and rapid removal of water, that are covered in this chapter, have been used in Germany in modified forms for the drying of other liquids.

The appendix consists of a compilation of German and English patents. Carl Bohm v. Bornegg has arranged these patents in chronological order.

Science of Distillation

ELEMENTS OF FRACTIONAL DISTILLATION. Second Edition. By *Clark Shove Robinson*. McGraw-Hill Book Company, New York, 1930. 255 pages. Price, $3.

Reviewed by A. A. BACKHAUS

THE new 1930 edition of Robinson's "Fractional Distillation" will be welcomed by everyone interested in the practice and science of distillation. The volume of 255 pages is considerably larger than the first edition. Chapters 1-7 inclusive, 9, 11, 12, and 14 to 20 inclusive, are the same in both editions.

Of the revised portions Chapter 8 has been enlarged to include eight pages on partial condensation, a subject of considerable industrial importance. In Chapter 10 the value for "A" is 1.263 whereas the old edition shows 1.287. Likewise the table given on page 67 differs from that of the old edition; no explanation for this change is indicated. The graphical method of McCabe & Thiele for number of plates is covered on pages 75-80 inclusive. In Chapter 13 the new edition includes data from recent work by Carey (M.I.T. thesis, 1930) on plate efficiency and boiling cap design.

The new chapters (21-25) deal primarily with the problem of fractional distillation in the petroleum industry. Genuine progress has been made in this field during the eight years which have elapsed since the first edition appeared. By treating the great number of compounds occurring in petroleum not as individuals but by groups, it has been possible to apply the principles of simple fractionation to the mixture of an untold number of hydrocarbons appearing in crude petroleum.

The Light Metals

L'ALLUMINIO, I METALLI LEGGERI E LE LORO LEGHE. By *E. Koelliker and U. Magnani*. Ulrico Hoepli, Milano, Italy, 1930. 468 pages.

Reviewed by C. L. MANTELL

IN a small volume the authors have compressed a surprisingly large quantity of specific information on the aluminum industry. The first part is of a general nature, devoted to the chemical-physical properties of aluminum, its compounds, and its ores. The second section reviews the refining methods for aluminous ores, such as the Bayer, Hoopes-Hall, Pedersen, and Haglund processes for bauxite, as well as a most interesting discussion of the Italian development of alumina production from silicates, such as leucite by the Blanc process, and a discussion of the acid and alkali methods for treatment of aluminum silicates. The commercial preparation of cryolite and aluminum fluoride are included in this section.

A third part contains the historical development of aluminum metallurgy, followed by a somewhat detailed description of alumina reduction and metal production. The technical details, description of plant, furnaces, and equipment are unusually well given. The fourth part treats of aluminum alloys with particular emphasis on those which have been developed on the European Continent, their properties, preparation, specific applications, and fabrication, which includes welding, rolling, stamping, drawing, forging, remelting, finishing, and coloring.

In the fifth part the discussion centers around the industrial application of commercial aluminum metal. There is a good section on corrosion in which specific chemicals and their action on the metal are discussed. Individual chapters of this part discuss aluminum in electrical engineering work, transportation, aviation, and other fields. The sixth part centers around magnesium and beryllium, their ores, metallurgy, and application. The seventh part concerns itself with the economic aspects of the aluminum industry, the producers of the

world, the world markets, future possibilities, competition with other metals, and the financial aspects of the entire aluminum industry.

In general the book concerns itself largely with the European picture, with which the writers are more familiar than they are with the American aspect. But all in all, the book is well done and certainly worth consulting for special purposes.

German Coking Studies

KOKEREIWESEN. Technische Fortschrittsberichte. By *H. Hock.* Theodor Steinkopff, Dresden and Leipzig, 1930. 172 pages. Price, 15.50 marks.

Reviewed by T. C. LLOYD

A REVIEW of the developments in byproduct coke oven operation of the past ten years. The following subjects are covered: Preparation of coal, insight into the coking process, coke ovens, tar removal, byproduct and benzol operation, liquor disposal, gas purification and utilization. An attempt is made to cover the chemistry of coal in eight pages, which would have been better omitted. The treatment is academic and the writer does not distinguish between those processes which have enjoyed a pronounced commercial success and those which have not developed beyond the patent stage. However, the literature is well covered, references are numerous and readily available, and the operator will find much of interest in the volume.

DIE VORGÄNGE BEI DER STÜCKKOKSBILDUNG. Kohle-Koks-Teer: Vol. 20. By *G. Agde* und *L. von Lyncker.* Wilhelm Knapp, Halle, 1930. 46 pages. Price, 7.90 marks.

AN ATTEMPT to cover the literature of the coking process from the scientific point of view. The purpose is poorly carried out and the writers show strong bias toward German research: the work of Parr and Wheeler is scarcely mentioned, whereas that of Fischer receives undue prominence. Thus, the literature references, which are numerous, are of doubtful value. Part 2 (24 additional pages), consists of data, curves, and the like, obtained by Fischer's benzene extraction method.

DER KOHLENSCHWEFEL. Kohle-Koks-Teer: Vol. 21. By *F. Muhlert.* Wilhelm Knapp, Halle, 1930. 139 pages. Price, paper cover, 13.80 marks; bound, 15.50 marks.

AFTER noting the minor part in spontaneous combustion played by sulphur, the writer deals with the reactions of sulphur during combustion and its subsequent effect on apparatus, buildings, and vegetation, with special reference to industry. Analytical methods for sulphur in solid and gaseous fuels are dealt with at some length and 50 pages are devoted to gas purification. Literature references are frequent and the volume is well arranged.

Chemistry of Batteries

STORAGE BATTERIES. Second Edition. By *George W. Vinal.* John Wiley and Sons, Inc., New York, 1930. 255 pages. Price, $5.

Reviewed by HELEN GILLETTE WEIR

IN BRINGING this work up to date, Dr. Vinal has performed a useful service to the technical public as well as the storage-battery industry. Certain sections have been much improved, notably that on the preparation of paste for lead oxide plates. Results of more extended work by the Bureau of Standards on the effect of impurities have been included and radio batteries and isolated lighting plants receive more attention. A new section on aircraft batteries has been added.

The omission of mention of the close relationship between buckling of the plates and deficiency in porosity for the service required, is to be regretted. However, in the six years since the first edition, this work has not been superseded and remains by far the best compendium in print of both theoretical and practical knowledge of the industry.

Bearing Metals

BEARING METALS AND BEARINGS. By *W. M. Corse.* Chemical Catalog Company, New York.. 374 pages. Price, $7.

IN ORDER that persons unfamiliar with the subject may become acquainted with the development and present status of the problems involved in bearings and bearing metals, this monograph begins with a brief history. Following the historical introduction is a bibliography containing over 1,800 references to papers on the subject. The bibliography is conveniently divided into sections, such as general papers, descriptions of particular alloys, structure and constitution of bearing metals, and other phases of the subject.

Over 200 pages are devoted to abstracts of 234 selected papers. Sixteen tables dealing with the properties of various bearing metals are given in part four of the book. The value of the book lies in the fact that it contains in one volume a comprehensive survey of the literature on the subject.

Text Books

GENERAL CHEMISTRY. Revised Edition. By *Harry N. Holmes.* The MacMillan Company, New York, 1930. 654 pages. $3.50.

Reviewed by E. B. KELSEY

APPRECIATING from his experience with the previous editions of the Holmes texts their virtues as well as their shortcomings, the reviewer welcomes this revision as a distinct improvement over its predecessors. Holmes' pleasant style is easily recognized, but nevertheless there has been a very general rewriting and the passages retained unchanged merit their inclusion.

The reviewer knows of no comparable text which is so up to date as this one, and where so many of the practical ramifications of chemical science are so pleasantly indicated. In fact, though not at all of the encyclopedic type, there is so much material in this book that the average college student will be hard pushed if he is expected to absorb all of it. However, the arrangement is such that it is easy to omit undesired portions, and the "inquiring student" (to use Holmes' own phrase) will find these sections of great interest. The text is fully illustrated by well-chosen diagrams and photographs.

INORGANIC QUALITATIVE CHEMICAL ANALYSIS. By *Allan R. Day.* Chemical Publishing Company, Easton, Pa., 1930. 197 Pages.

Reaction to the recent comparative neglect of qualitative analysis in favor of quantitative is the purpose of this book. Following a treatment of the fundamental principles it proceeds to the analysis of various ion groups in very thorough fashion.

SELECTIONS FROM RECENT LITERATURE

OPERATING GAS PRODUCERS. L. Muir Wilson. *Fuel in Science and Practice,* April, pp. 152-64. Practical considerations involved in successful operation of gas producers are discussed, with only such attention to features of producer design as is necessary to the presentation. Proper starting is emphasized, on the grounds that this phase of the work is generally neglected in instructing beginners, and even in practice is often improperly done. Importance of a properly laid ash bed, made of infusible ash, is stressed; and selection of coal in which the ash also is infusible is urged. This is more important than low ash content in the coal. Ratio of volatile matter to fixed carbon is to be chosen in accordance with the required richness of the gas, figuring on the basis of the relative yields and thermal values of the gas formed from the volatile matter and the fixed carbon. Sulphur and moisture are both harmful, and the coal should be as nearly as possible free from these impurities. Coking coals, which are likely to be friable, are to be avoided. Presence of fines is detrimental, because the dust is blown into the mains. As limiting values, the ash (if white and infusible) may run as high as 20 per cent; volatile matter should be over 35 per cent, and moisture under 3 per cent. Regeneration is important not only for raising the sensible heat (commonly supposed to be its only function) but even more for absorption of heat from restoration of chemical equilibria, splitting of hydrocarbons, etc. Proper firing and control of the amount, velocity, and moisture content of the blast are leading factors in keeping up yield and quality of gas. A gas governor should be used to adjust the steam content of the blast. A typical weekly cost statement for a producer is shown.

HEAT TRANSFER. Franz Elias. *Zeitschrift für angewandte Mathematik und Mechanik,* December, p. 453; February, pp. 1-14. A comparison is made of experimental observations with the mathematical theory of heat transfer from a heated plate to a stream of air. The experiments were conducted in such a way as to permit comparison of the temperature ranges with the corresponding velocity ranges, and also of heat transfer with resistance to gas flow. A thermo-element was especially designed for systematic temperature measurements at the boundary surface, and determinations are reported of the temperature limits and the velocity limits along the hydrodynamic boundary of a heated plate. The observed results agree well with the mathematical reasoning, and with calculations previously made, on theoretical grounds, by von Karman and Prandtl. The experimental results clearly show that there is actually an analogy between heat transfer and resistance to gas flow along the boundary surface of the plate. Numerous curve charts visualize the experimental data and show the relations of observed facts to theory.

TOWER FILLINGS. Chas. H. Butcher. *Industrial Chemist,* February; pp. 51-2. An excellent example of the perfected use of bulk tower fillings (Raschig rings, Lessing rings, Bregeat multiple spirals, etc.) is found in the scrubber method of debenzolizing gas. A study has therefore been made of the efficiency of Raschig rings in a benzol extraction tower. Ordinarily, the concentration of benzol in wash oil cannot be made to exceed 2 per cent. With maximum tower efficiency, this may be raised to 3 or even 4 per cent, the necessary conditions being uniform distribution of scrubbing surface throughout the tower space and high ratio of available scrubbing surface to tower space. Data are reported from use of Raschig rings, as a type of the tower fillings which are used in bulk without systematic arrangement, without supposing these rings to be superior to other kinds of rings or spirals. Each design has its own merits for specific purposes. It is important that the tower shall be properly proportioned with respect to the rate of flow of gas and to the quantity of wash oil used. In large gas works the preferred practice is counter-current extraction in three towers connected in series. This permits continuous extraction. From operating results of a plant treating 100,000 cu.m. of gas per 24 hours, it was found easy to raise the benzol concentration in the wash oil to 3 per cent, and quite feasible under favorable conditions to achieve a concentration of 4 per cent. When the naphthalene content of the wash oil is so high that the treated gas begins to take up naphthalene, an additional scrubber (also filled with Raschig rings) is used for removing the naphthalene.

Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Specifications of Federal Standard Stock Catalogue Board as follows: ZZ-T-391, Solid Automobile Tires (supersedes part of U. S. Government Master Specification 3c), mandatory date, Aug. 1, 1930, 5 cents; and ZZ-T-721, Automobile and Motor-Cycle Inner Tubes (supersedes part of U. S. Government Master Specification 3c.), mandatory date Aug. 1, 1930, 5 cents.

Industrial Alcohol — The Government's Policy and Problem Relating to the Manufacture, Storage, Distribution, and Sale of Alcohol for Lawful Use in the Arts and Industries. Monograph issued by the Bureau of Prohibition.

Subject Index of United States Tariff Commission Publications, Revised March, 1930. U. S. Tariff Commission. 10 cents.

Tariff Act of 1930, with index, issued as Public Law No. 361. House Document 476, 71st Congress, 2d Session; 20 cents.

Selection Characters as Correlated With Percentage of Sucrose, Weight, and Sucrose Content of Sugar Beets, by Dean A. Pack. Reprint from Journal of Agricultural Research, Vol. 40, No. 6; March 15, 1930.

Factors Affecting the Mechanical Application of Fertilizers to the Soil, by Arnon L. Mehring and Glenn A. Cumings. U. S. Department of Agricultural Bulletin 182; 30 cents.

Sodium Oxalate as a Standard in Volumetric Analysis. Bureau of Standards Circular 381; 5 cents.

Pulp-Wood Crops in the Northeast. U. S. Department of Agriculture leaflet No. 57; issued March, 1930; 5 cents.

Summary by Industry Groups and by Industries From the Census of Manufactures for 1927. Issued by the Bureau of the Census; 10 cents.

Production statistics from 1929 Census of Manufactures in preliminary mimeographed form for: Oilcloth; Linoleum and Asphalted-Felt-Base Floor Covering; and Corn Sirup, Corn Sugar, Corn Oil, and Starch.

Consumption of Vegetable Tanning Materials, 1929. Compiled by the Department of Commerce in co-operation with the Department of Agriculture. Issued by the Department of Commerce in mimeographed form on June 26, 1930.

Innovations in Copper Leaching Employing Feric Sulphate-Sulphuric Acid, by Harmon E. Keyes. Bureau of Mines Bulletin 321; 20 cents.

Chemistry of Leaching Chalcocite, by John D. Sullivan. Bureau of Mines Technical Paper 473; 10 cents.

Mineral production statistics for 1929 —preliminary mimeographed statements from Bureau of Mines on: Lead and zinc pigments and zinc salts, fuller's earth, feldspar, asphalt, slab zinc and rolled zinc, natural abrasives, coal-tar crudes, liquefied petroleum gases, platinum and allied metals, gypsum, magnesite, mercury, metallic cadmium, clay and magnesium.

EQUIPMENT NEWS
FROM MAKER AND USER

Centrifugal Acid Pump

EXTENDING its line of "Olivite" acid pumps, Oliver United Filters, Inc., San Francisco, Calif., has introduced a compact 1½-in. pump for either direct motor drive or belt drive. Olivite pumps have previously been made only in the 2-in. size, which has also been improved in a number of details.

The new 1½-in. pump is illustrated in the accompanying view, which shows it

Unit-Type, Direct-Connected 1½-In. Acid Pump

to be built as a unit. The type of motor mounting employed permits the use of the motor bearings for the pump shaft, considerably simplifying the construction. The two sizes of pump provide capacities from 10 to 200 g.p.m., while the maximum head for the 1½-in. pump is 60 ft. and for the 2-in. pump, 100 ft. at 1,750 r.p.m. These pumps are said to have chemical resistance equal to that of hard rubber through the use of the lining material, "Olivite," which is vulcanized to the iron casing and impeller, but it is claimed that this material will not crack and that it withstands comparatively high temperatures. It may be used, according to the manufacturers, with practically all acids and corrosive liquors except concentrated nitric acid, at temperatures close to the boiling point and at pressures up to 50 lb. per square inch.

Centrifugal Dust Collector

WESTERN PRECIPITATION Company, Los Angeles, Calif., after three years of development, has announced a new high-efficiency dust collector known as the "Multiclone." Although this company handles the Western rights for the Cottrell precipitator, and cement mill rights for the entire United States, it points out that many applications for dust-collecting equipment are too small to justify the cost of a Cottrell.

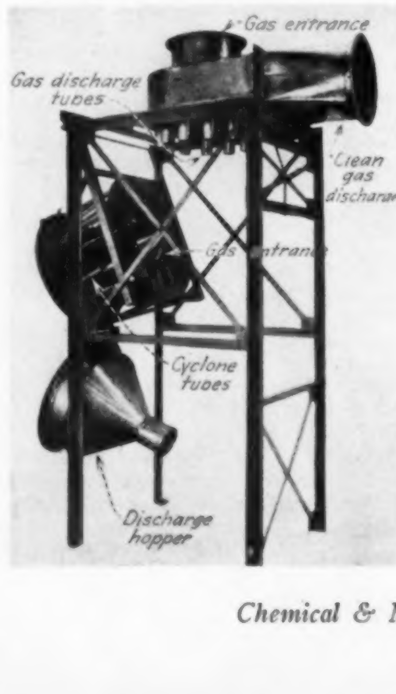
It was for this reason that the Multiclone was developed. It is well known that the efficiency of a centrifugal dust collector increases with decrease in the radius of the gas path. Efficiency also was found to vary directly as the square of the tangential velocity of the gas. Therefore, the new collector was designed so that a number of cyclones of very small diameter and considerable length could be used in parallel. The accompanying illustration shows one style of collector which was developed along these lines. This is known as the involute type. Dust-bearing gas enters the nozzle at the top, passing downward over the cone shown at the center of the center section and entering the involute which surrounds the upper part of each of the cyclone tubes. The gas path in each tube then becomes a downward spiral. Dust is thrown to the outside, while the gas, as it approaches the bottom of the tapered portion of the tube, reverses and passes up through the small nozzles projecting downward from the upper section. Gas then discharges into a chamber surrounding the intake and passes out through the horizontal nozzle.

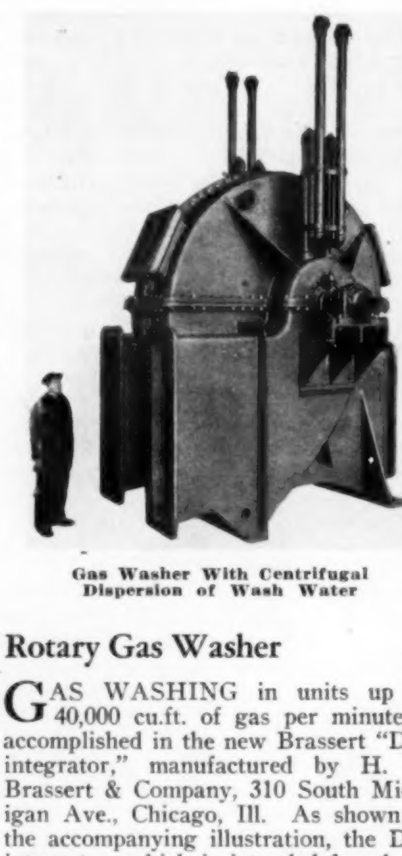
Very remarkable recovery is claimed for this new device. Efficiency will vary with the size and specific gravity of the particles, but it is claimed that the collector will catch all particles down to 6 microns and in some cases has collected particles of an average size of 3 microns. In some cases practically 100 per cent collection is possible and in many instances 95 to 98 per cent recovery is said to be obtained. This compares with 70 per cent recovery or less with an ordinary cyclone.

Other claims for advantages of the new collector include low draft loss, construction in materials to suit corrosion difficulties, and extremely low maintenace. The collector is made in various sizes and styles to handle gas in any quantity up to the amount which may be economically handled in a Cottrell.

New "Multiclone" Dust Collector of Type Readily Opened for Cleaning or Inspection

This collector consists of 12 small-diameter cyclones arranged in parallel. Gas enters the top, passes down and tangentially into the cyclones; dust is thrown out of the gas stream and falls into the hopper at the bottom while the gas reverses, passes up through the nozzles and out at the right.





Gas Washer With Centrifugal Dispersion of Wash Water

Rotary Gas Washer

GAS WASHING in units up to 40,000 cu.ft. of gas per minute is accomplished in the new Brassert "Disintegrator," manufactured by H. A. Brassert & Company, 310 South Michigan Ave., Chicago, Ill. As shown in the accompanying illustration, the Disintegrator, which is intended for cleaning all kinds of gases, consists of a cast-iron housing which is split on both the horizontal and vertical axes. Attached to the housing inside the machine are circular rows of stationary blades, between which circular rows of blades, mounted on the rotor, revolve.

The rotor consists of a heavy shaft on which is mounted a steel disk bearing the rotating blades. Around the shaft and connected to the disk on each side are water-distributing baskets from

which several short pipes radiate. Water is fed into the baskets from outside by four gravity feed pipes.

As the rotor rotates, the water is thrown by centrifugal force through these pipes, against the rotating and stationary blades, which break the water up into fine mist. Gas which is passed through the washer then comes into intimate contact with the mist and the dust is thrown to the bottom of the Disintegrater, passing out with the water to the sewer, as the specific gravity of the dust particles is increased upon wetting. Low consumption of both water and power is claimed by the manufacturers.

Flake-Ice Machine

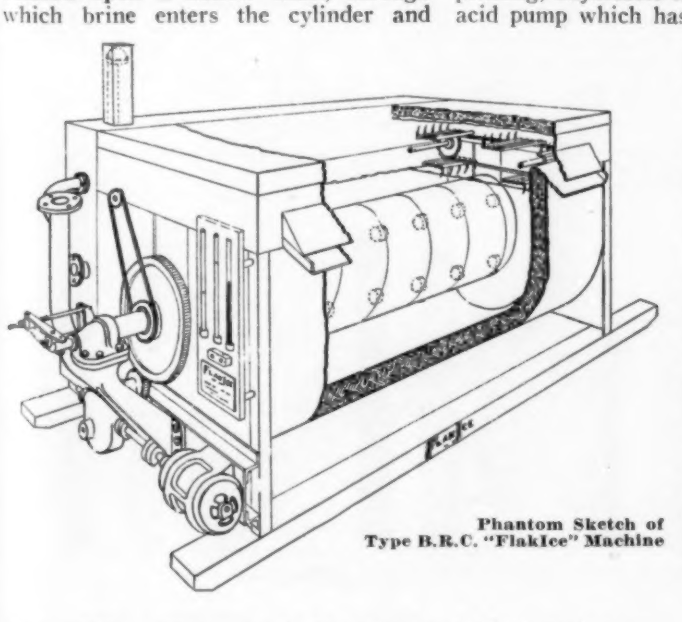
AT THE JUNE meeting of the American Institute of Chemical Engineers, Crosby Field described his invention, the "FlakIce" machine, which is now being manufactured by the FlakIce Corporation, 205 Water St., Brooklyn, N. Y., of which Mr. Field is president.

In his paper he pointed out that cake ice melts very slowly, preserving substantially the same shape as it melts. Thin flakes of ice, however, have much greater surface to start with and melt so that their surface remains substantially constant. This is the explanation of the results obtained by Mr. Field in experiments, which showed that a 10-lb. cake of ice, substantially cubical, required 12½ times as long to melt as the same weight of flake ice under the same conditions. For this reason, it is claimed that flake ice, in addition to being cheaper than ordinary forms of ice, is especially suited to cooling operations where the time element is important.

The machine which has been developed by Mr. Field consists of a cylinder of flexible metal, such as Monel or nickel, built up of comparatively wide strips running around the periphery. These are joined together by means of rubber strips. The cylinder is supported and rotated upon a hollow shaft, through which brine enters the cylinder and through which the shaft actuating the mechanism for removing the ice is operated. The cylinder is mounted within a tank, where it is submerged in water. Within the cylinder are a series of rollers mounted upon toggles so that they may be pressed against the inner surface at intervals, distorting it so as to crack off any ice which has formed.

Brine enters the cylinder, which is rotated continuously by means of a motor driving through a reducing gear, and overflows to a surge tank. Ice forms a thin film on the cylinder surface, between the rubber bands, and is cracked off in flakes at intervals by the distorting mechanism. The type of flake produced is always under control of the operator. The flakes rise to the surface of the water and are removed by a conveyor, which gives them an opportunity to drain before discharging them from the machine.

These features of the machine are indicated in the accompanying illustration. Small cost of ice, highly efficient utilization of the refrigeration so produced, and small floor space for the equipment are principal claims of the manufacturer.



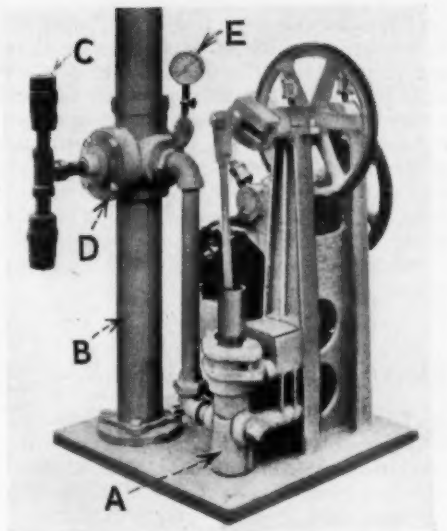
Phantom Sketch of Type B.R.C. "FlakIce" Machine

Gas-Electric Locomotive

DRAWBAR PULL of 8,000 lb. at a speed of 3 m.p.h., and a maximum speed of 18-20 m.p.h., are features of a new gas-electric locomotive for industrial purposes manufactured by the Vulcan Iron Works, Wilkes-Barre, Pa. A 120-hp. gasoline engine drives a 250-volt direct-current generator and furnishes electricity to two Westinghouse mine haulage motors which are geared to the axles. Arrangements are made to utilize the exhaust for heating the cab in cold weather. The locomotive is 13½ ft. long over all, 7 ft. wide and 8 ft. high.

Rubber Acid Pump

RUBBER as the only material which comes in contact with the liquid being pumped, is a feature of a new self-priming, adjustable-stroke, plunger-type acid pump which has been placed upon the market by the Paige & Jones Chemical Company, Hammond, Ind. The accompanying halftone shows this pump to consist of a single unit with the motor driving a plunger pump, *A*, of conventional type, through gearing and a variable-stroke crank. This pump, however, is without valves and is connected by a single pipe to cylinder *B*. Hanging in the center of cylinder *B*, there is a gum-rubber sack which is attached by hard-rubber piping to hard-rubber fittings and check valves, *C*.



Rubber-Sack Acid Pump Which Employs Hydraulic Piston

The pump and the cylinder, *B*, form a closed system which is filled with the water. At the upper part of cylinder, *B*, there is mechanism for eliminating air which may collect in the water and for keeping the system always filled. The water, therefore, acts as a hydraulic piston upon the rubber sack.

Acid is sucked into the sack upon the upstroke of the plunger and discharged upon the downstroke. It will be noted that the sack is not called upon to withstand any appreciable differential pressure although the standard pump is capable of discharging at 125 lb. pressure. Special pumps may be built to handle greater pressures. The standard machine is available in three maximum capacities of 1, 2½, and 5 g.p.m.

First-Aid Kit

NOW LICENSED to manufacture the Standard Oil Company of California's patented aluminum first-aid kit, Bullard-Davis, Inc., 67 Wall Street, New York, has introduced this device under the Bullard name. The kit is cylindrical in shape and is made of drawn aluminum for convenient mounting on a wall or in other locations. Within the kit the first-aid material is kept in unit packages rolled in a durable duck roll-up. This is easily removed from the kit and carried to the injured man. This feature also simplifies and speeds up the job of maintaining the kit, according to the manufacturer.

Flux-Coated Welding Rod

WELDING SPEED has been substantially increased, according to the Fusion Welding Corporation, 103d Street and Torrence Avenue, Chicago, by means of a new rod designed for carbon-arc welding, and intended particularly for the welding of mild steel plate and castings. The new rod, known

as "Weldite C—No. 6 Fluxed," has a flux coating which is said to cause the arc to pull from the hottest part of the weld puddle, rather than jumping to the colder edges as usually is the case with the carbon-arc process. This, according to the manufacturer, accounts for speeds higher than are possible with bare filler rods, giving at the same time a weld which is strong, sound, and ductile. It is further asserted that only one layer of deposit metal is required.

Electric "Safety Valve"

MOST MATERIALS are ordinarily considered to be either electrical insulators or conductors. A new material recently developed by the Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., has the remarkable property of being a good insulator below

New Arrester Working on Glow Discharge Principle at Left, Compared With Old Style of Arrester at Right

a certain applied voltage, and a good conductor above that voltage. When voltage exceeds this critical value, the material changes in time shorter than can be measured into a conductor and permits current to flow freely in any quantity necessary to prevent the rise of voltage above the critical value. The material is of a ceramic nature and is permeated by millions of fine pores through which electric discharge takes place when the applied voltage reaches the critical value. It is estimated that the total pore surface in a block 1 in. thick and 2 in. in diameter is 200 sq.ft., about 2,200 times the surface area.

At present the new material is being used in lightning arresters. The compactness of arresters made up of such units is shown at the left in the photograph, as compared with the old style unit shown at the right.

Right-Angle Speed Reducers

SPIRAL BEVEL gears mounted on Timken roller bearings are used in a new line of right-angle speed reducers, made by the D. O. James Manufacturing Company, 1114 West Monroe Street, Chicago. These reducers are made in both horizontal and vertical types, in the latter with the slow speed shaft extended either upward or downward.

These reducers are made in ratings ranging from ¼ to 100 hp. with ratios of 1-1 to 6-1. A combination of the spiral bevel gears with planetary spur gears is used for ratios from 8-1 to 1,600-1 or more. Splash lubrication is employed in all models.

Two-Range Generator

SIMPLIFIED CHANGING of voltage is provided for in a new double-commutator type of electroplating generator which has been announced by the Columbia Electric Manufacturing Company, 1292 East 53d St., Cleveland, Ohio. External connections on the new machine may easily be changed by taking off four nuts and reconnecting heavy bus links in the proper manner for the voltage desired. It is possible to change very quickly from 6 to 12 volts or vice versa. This permits the same generator to be used both for still-tank plating and for barrel plating.

Shock Absorber for Gages

AVERAGE PRESSURE resulting from pulsating flow, as in the case of air compressors without air receivers, or the discharge from piston pumps not equipped with air cushions, may be obtained through the use of a shock absorber for pressure gages, recently put upon the market by the Meriam Company, Cleveland, Ohio. This device consists of a steel airtight chamber in which is a long spiral coil of small-bore tubing. The chamber contains air and is attached to the gage. Pulsations in the pipe line are largely dissipated by friction in passing through the long, narrow bore of the tube, while the cushioning effect of the air in the chamber itself absorbs any remaining pulsation, giving an average reading at the gage.

New Metal for Chains

CAST CHAINS of a new metal, known as "Promal," have been announced by Link-Belt Company, Indianapolis, Ind. As the accompanying chart shows, the new metal has an average yield point, an ultimate tensile strength, and a Brinell hardness considerably higher than either malleable iron or mild cast steel. The chains produced from the metal, therefore, are said to withstand abrasion much better than the usual cast chain, at the same time being tough and ductile to withstand shock and fatigue loads. Temperatures up to 1,000 deg. F. are said not to cause the metal to become brittle.

It is stated by the company that these chains have been tested in the field for three years prior to announcement. In a cement mill they are reported to have lasted more than twice as long as the malleable chain previously used and still showed no evidence of serious wear. On a tumbling barrel drive, Promal chains lasted six times as long as malleable chain. These chains are specially recommended for elevator and conveyor drives operating under gritty or abrasive conditions; drives where great strength is required; drives for drag, scraper, and flight conveyors where abrasion is encountered; and heavy-duty drives for comparatively high speeds and short centers.

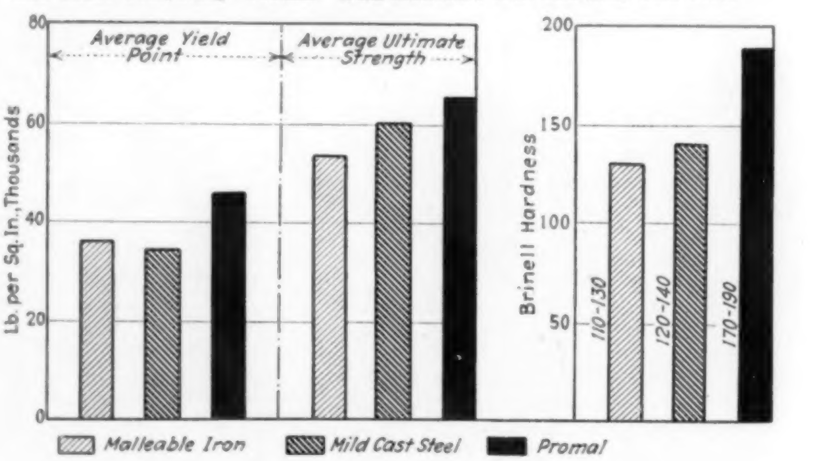
Mechanical Grease Lubricator

MUCH heavy equipment now in use in the chemical engineering industry must be lubricated frequently with grease at a considerable number of points. For this purpose, the Hills-McCanna Company, 2349 Nelson St., Chicago, Ill., has introduced a new positive-feed lubricator of the Anderson mill type.

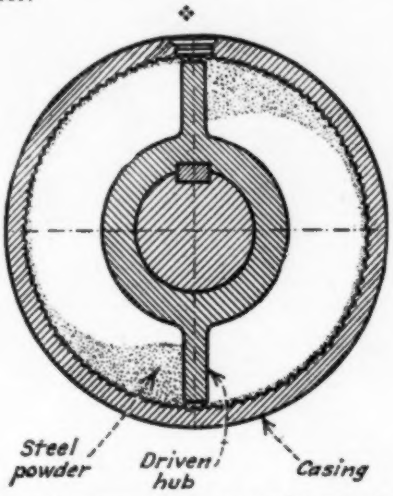
In this device, grease is introduced into the pressure pump from a hopper of 50 lb. capacity, by means of a displacement pump, discharging through a positive mechanical valve. During the suction stroke of the main or pressure pump, an indexing device connects the discharge of this pump with one of the leads or pipes connecting with one of the bearings being lubricated. After positive discharge of a measured quantity of grease into the first lead, the pump again receives a supply of lubricant on its suction stroke, while the index device connects the pump discharge with the next lead, which operation is continued until all of the leads have been served, whereupon the lubricator repeats the cycle.

These lubricators, it is claimed, will deliver grease against bearing pressures up to 5,000 lb. per sq.in., and are supplied in sizes of 4 to 12 feeds per unit. Special sizes are made up to 24 feeds per unit. Special features include a steam heating element in the hopper,

Bar Chart Comparing "Promal" With Malleable Iron and Mild Cast Steel



and complete adjustability of the quantity fed per bearing per cycle. The lubricators are supplied with motor direct-connected through a speed reducer.



Schematic Cross-Section of Clutch Showing Powder Drifts Ahead of Wings

Novel Clutch

A RECENT TENDENCY in clutch design provides for allowing the motor to come to speed before applying the load, after which the load is gradually accelerated to the motor speed. The Pluvis clutch, developed in Sweden, is one of this type, and has recently been introduced into this country by Nils Wallenius, 114 East 52d Street, New York.

An accompanying drawing shows schematically how the new clutch functions. Its principal parts consist of a cylindrical casing, the inner surface of which is corrugated. The casing constitutes the driven part of the clutch. The driving side consists of a winged hub, which is free to revolve within the casing. Steel powder is then loaded into the casing. In operation the powder forms in drifts ahead of the wings, as shown in the drawing, and by centrifugal force the density of the powder drift is increased to a point where the friction on the corrugated surface of the housing is sufficient to hold the two members stationary in relation to one another. However, should the load increase above the point for which the coupling is designed, the machine simply slows down while the motor continues to run at approximately normal speed.

Changes in the type of powder used permit practically any accelerating characteristics desired. The clutch is made both in a pulley type and for direct-connected units.

Airplane-Type Industrial Fan

TO ROUND OUT its line of "Heat Killers," the Coppus Engineering Corporation, Worcester, Mass., has developed a portable airplane-type blower for circulating the air in factories and cooling operators engaged in hot occupations. Two blowers are included in this line. The first weighs 250 lb., is operated by a 1-hp. motor, and moves 10,500 c.f.m. of air at a velocity of 2,600 ft. per minute. The second weighs 270 lb., uses a 3-hp. motor, and moves 15,600 c.f.m. of air at a velocity of 3,850 ft. per minute. The blowers consist of a four-bladed propeller driven by a motor and mounted in the center of a tubular diffuser and inlet thimble. The entire assembly is mounted upon a tripod.

The manufacturer points out that this new development is a volume blower as contrasted with the blast fans previously announced in these columns, and as such is capable of cooling a considerable area by means of a comparatively gentle breeze.

Totally Inclosed Motor

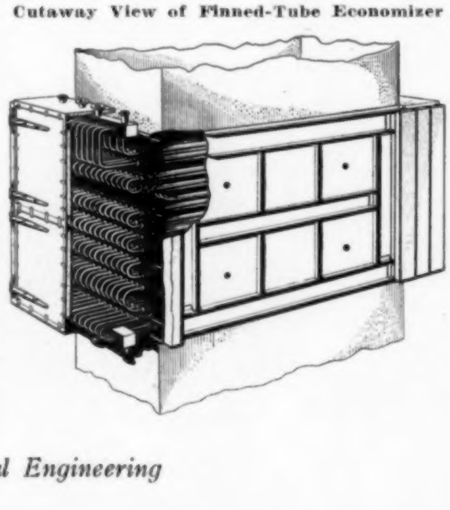
A RECENT development of the Century Electric Company, St. Louis, Mo., is a totally inclosed, fan-cooled motor, which in most of its ratings is approximately the same size as a standard open motor of the same rating. In addition to small size, it affords the added advantage of protection to the stator, rotor, and other internal parts of the motor.

The motor is completely inclosed with ribbed cast-iron guards. Cooling air is drawn in at the pulley end, circulated through the air passages between the core and the frame, passing meanwhile over the front and rear coil guards, and out through the fan and fan housing. The air passages may be completely blown out if necessary. Provision also is made to circulate the air within the motor shell, so as to facilitate heat transfer to the radiating surfaces, from which it is carried away and dissipated by means of the cooling air.

Extended-Surface Economizer

FINNED TUBES have been used by the Combustion Engineering Corporation, 200 Madison Ave., New York City, in a new economizer which, it is said, can be installed in considerably less than half the space required for the plain-tube type. The principal features, as shown in the illustration, include external and internal return bends, and the use of finned tubes to provide additional heat absorbing surface. Resistance of the new economizer has been reduced, according to the manufacturer, to about one-fifth that of the plain-tube, single-circuit type. This is made possible by the decrease in necessary tube length inherent in extended-surface tubes.

Cutaway View of Finned-Tube Economizer



Overhead Handling Equipment

AN ELECTRIFIED "Cyclone" chain hoist has been announced by the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y. The new hoist is said to be inexpensive, at the same time giving a lifting speed three times greater than that of a hand hoist. The lifting medium is chain and the moving parts are operated by means of a small ball-bearing motor with built-in magnetic brake. The hoist is suspended from a trolley and may be rotated about its vertical axis for convenience in handling. It is said to be light and easy to transport from place to place.

The company has also announced a new line of ball-bearing trolleys which are made of malleable iron with heavy reinforced ribs. The wheels are of pressed steel with built-in ball bearings. They are provided with fittings for high-pressure lubrication. These trolleys are said to be light in weight and adaptable in the 1- and 2-ton sizes for any standard I-beam up to 15 in.

New Portable Graphic Voltmeter

Graphic Electrical Instruments

ADDING to its line of indicating electrical instruments, the Roller-Smith Company, 233 Broadway, New York City, has announced two new groups of recording instruments, Type AG for alternating current and Type DG for direct current. These include switchboard, wall, and portable models of ammeters, voltmeters, single- and polyphase watt meters, and power-factor meters. The standard and special ranges which the company is prepared to furnish are said to cover practically all possible requirements. Special claims for the features of the new line include a dependable eight-day clock, positive chart drive, long life and

low maintenance, easy accessibility of all parts, and magnetic damping on all types.

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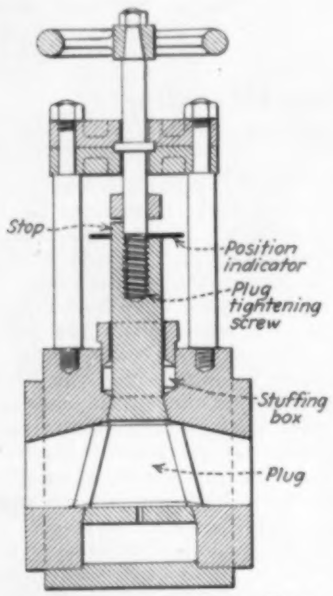

Cross-Section of New Non-Sticking Plug Valve

Non-Sticking Plug Valve

FREEDOM from sticking and scoring of the plug is said to be assured in a new valve which has been introduced by the Diamond State Machine Works, 12th and Madison Sts., Wilmington, Del. This is known as the Riepling plug valve. It features construction which causes the unseating of the plug before it is moved to a new position, either to open or to shut the passage.

The accompanying drawing shows the new valve in section. As the handwheel is turned, either to open or to shut the valve, the plug is lowered slightly through the action of the screw, and as the wheel is turned farther, the plug turns until the correct position is assumed. Then the wheel is reversed and the plus is again seated. An indicator on the stem shows the position of the plug.

The manufacturers suggest this new valve particularly for use with acids, solvents, oils, and hot asphaltum. The valve may be had in all sizes and types and may be made in all commercial materials, to meet any requirements.

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New Electrical Equipment

RECENT ANNOUNCEMENTS of the General Electric Company, Schenectady, N. Y., describe two new developments in connection with electrical control. The first is a thermostat for controlling industrial heating units where very close control of the heat is not desired. The thermostats are available in three ratings with operating ranges of 60-200 deg. F., 150-300 deg. F., and 250-400 deg. F. Capacity is 15 amp. at 115 or 230 volts a.c. or ½ amp. at the same voltage d.c. The thermostat operates with a differential of 5 per cent of the maximum temperature range.

The second development is a new automatic time switch for closing and opening electric circuits at short predetermined intervals and on a uniform schedule. The time cycle, which may be a few minutes or several hours, is controlled by a synchronous motor of the type used in clocks, and is repeated continuously. The switches are rated at 5 amp. at 115 volts.

Manufacturers' Latest Publications

Acid-Proof Cement. SIP Industrie-Gesellschaft Für Prodorite, Pratteln, Switzerland—52-page book describing Prodorite, a new acid-resistant material composed of sized quartz and a special pitch which is poured at high temperature. This material is said to have the strength of reinforced concrete. Its applications are described. Booklet is in German.

Apparatus. Eimer & Amend, 3d Ave. and 18th Sts., New York—Publications as follows: Bulletin 448, describes Pitschner electrometric apparatus for control of nickel plating solutions; Bulletin 450, Pitschner electrometric apparatus for hydrogen-ion determinations; Bulletin 444, describes a Travis laboratory colloid mill.

Bearings. Timken Roller Bearing Co., Canton, Ohio.—Bulletin T-20—Complete 16-page discussion of the application of Timken bearings to rubber mill equipment. Describes methods of load determination on rolls, application to roll equipment of all kinds, tube machines and other tire equipment, materials handling equipment, motors, etc.

Castings. Wm. J. Sweet Foundry Co., 8 Lister Ave., Newark, N. J.—Revised Sweetaloy castings chart covering this company's complete range of chrome-iron and chrome-nickel-iron alloys.

Chemicals. Roessler & Hasslacher Chemical Co., 10 East 40th St., New York.—Bulletin 493—June 15, 1930, price list of chemicals made and/or sold by this company.

Condensers. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 5-AA—16-page booklet concerning barometric multi-jet condensers.

Control. American Radiator Co., 40 West 40th St., New York.—Form 8997—Leaflet describing a new Mercoid thermostat for control of heating, refrigeration and general industrial work.

Controllers. Consolidated Ashcroft Hancock Co., Bridgeport, Conn.—Catalog 2200—8-page catalog describes self-operated temperature and pressure controllers made under the name of "American Precision" by this company.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Catalog GEA-600A—New 1146-page general catalog, 8x10½ in., thumb-indexed in 16 sections including generation, wire and cable, distribution transformers, arresters and capacitors, voltage regulators, switching equipment, switch gear, meters and instruments, lighting equipment, motors, motor applications, industrial control, transportation, industrial heating, miscellaneous and indexes.

Electrical Equipment. Rockbestos Products Corp., New Haven, Conn.—Bulletin 10—Gives construction specifications and applications of Rockbestos insulated wires and cables for heat and corrosion resistance.

Electrical Equipment. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 171—16-page bulletin discussing the correction of poor power factor through the use of the Fynn-Weichsel motor.

Equipment. Elmore Centrifugal Products Corp., 6527 Manchester Ave., St. Louis, Mo.—Leaflet describing and explaining a continuous counter-current washer made by this company.

Equipment. Huron Industries, Inc., Alpena, Mich.—Loose-leaf catalog containing sections devoted to power transmission equipment, including: speed reducers, couplings, and base plates; seal rings for rotary kilns, dryers and coolers; heavy duty vibrating screens; and feeders for dry, pulverized materials.

Equipment. Robinson Mfg. Co., Muncy, Pa.—Folder briefly describing mixing, conveying and sifting equipment made by this company.

Equipment. Weaver Bros. Co., Adrian, Mich.—Folder describing special pickling baskets made by this company.

Fluids Handling. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 8-R—20-page booklet describing the Venturi reducing valves and other pressure regulators made by this company.

Heat Insulation. Calicel Products, Inc., 310 South Michigan Ave., Chicago, Ill.—8-page booklet describing the properties and uses of Calicel heat insulating materials.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 6301—8 pages discussing the permanent installation of graphic instruments in industry.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Bulletin 880—8-page pamphlet explaining and describing the principle of the direct reading humidity recorder made by this company. Notebook No. 3, 48-page non-catalog handbook on electric methods of hydrogen-ion measurement; also leaflet describing a quinhydrone pH indicator.

Materials Handling. H. W. Caldwell & Son Co., 2410 West 18th St., Chicago, Ill.—Book 1191—32 pages illustrating and describing the complete line of Caldwell screw conveyor drives; complete with illustrations, typical installations, and engineering data.

Materials Handling. Cleveland Electric Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio.—Forms TR. 6130 and 6230—4-page folders describing use of Tramrail equipment in the rubber industry.

Metals and Alloys. Southern Manganese Division, American Manganese Steel Co., 6600 Ridge Ave., St. Louis, Mo.—Leaflet describing the application of Fahralloy in piping for resistance to corrosion by nitric and acetic acids and silver nitrate.

Platinum. American Platinum Works, New Jersey R.R. Ave. & Oliver St., Newark, N. J.—Catalog 16—43-page catalog on platinum laboratory ware with information regarding the metal and its care.

Power Transmission. D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill.—Mailing piece briefly describing stock speed reducers carried by this company for immediate shipment.

Power Transmission. Worthington Pump & Machinery Corp., 2 Park Ave., New York—Bulletin L-400 B-I—8-page booklet describes the new multiple-V-belt drive now made by this company.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 201—32-page book completely describing the multi-stage centrifugal pumps made by this company; includes selection charts for determining the size and style of pump for any given condition.

Pumps. Oliver United Filters, Inc., San Francisco, Calif. — Bulletin 301 — 4-page booklet describing the line of Olivite centrifugal pumps for acid service.

Pumps. Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletin 215—16-page booklet describing and illustrating double-suction, single-stage centrifugal pumps.

Refractories. Corundite Refractories, Inc., Massillon, Ohio.—62-page revised catalog and handbook of refractories made by this company including high aluminous and firebrick refractories, cements, fireclay and special shapes.

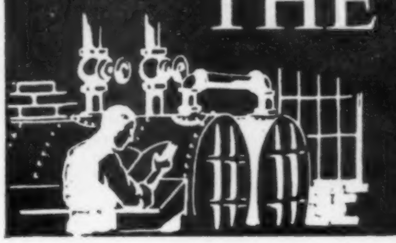
Safety. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Leaflet describing a new Hydro-Picric ointment for the treatment of burns.

Steam Generation. Griscom-Russell Co., 285 Madison Ave., New York—Bulletin 361—35-page book illustrating and describing the system of boiler feed-water evaporation made by this company.

Stoneware. General Ceramics Co., 225 Broadway, New York — Bulletin DD — 4 pages describing and giving dimensions of flanged pipe and fittings made of acid-proof chemical stoneware.

Water Supply—Henry I. Lea, Mesa and Latimer Rds., Santa Monica, Calif.—14-page book describing the Lea distillation process for the recovery of pure water from seawater.

X-Ray Apparatus. J. B. Hayes, Urbana, Ill.—Bulletin 10—12-page booklet describing apparatus and accessories for diffraction X-ray work.



THE PLANT NOTEBOOK

"Cork-Borer" Bale Sampler

By Lionel K. Arnold
Engineering Experiment Station
Iowa State College
Ames, Iowa

IN THE RESEARCH on the utilization of cornstalks at Iowa State College it became desirable to have a method of sampling the bales of cornstalks which would give representative samples without breaking open the bales. No device of this sort could be found on the market so it was necessary to construct one.

The sampler constructed resembled a gigantic cork borer except that the cutting edge was provided with saw teeth. The tube was made from a piece of Shelby seamless steel tubing, $2\frac{1}{2}$ ft. long, and 3 in. in diameter, with a wall approximately $\frac{3}{16}$ in. thick, and 0.20 to 0.30 per cent carbon content. At one end of the steel tube were welded the handles which extend out from each side of the tube about 10 in. The handles were welded to a steel collar around the end of the tube rather than across the end. It is necessary to leave the end of the tube open so that the sample may be pushed out. Saw teeth were filed in the other end of the tube, and the end tempered to the proper hardness.

Samples were cut from the bales in the same manner as a hole would be bored in a cork with a cork borer. The cylindrical sample was pushed out of the tube by a suitable wooden stick or steel rod. This method of sampling is rapid and gives an average sample of the bale, extending through the breadth or depth.

This 3-In. Diameter "Cork Borer" Samples Any Baled Material

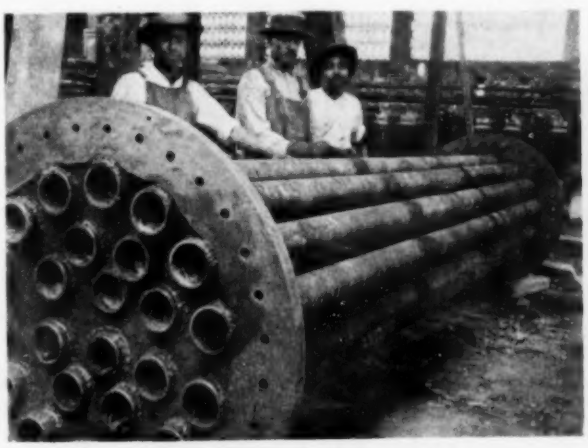
Although this sampler was designed for, and used in, sampling baled cornstalks, it operates successfully on many similar materials such as baled hay and straw, and doubtless could be adapted to many products.

Airtight Joints by Electroplating

By J. B. Calva
Research Chemical Engineer,
Baeder Adamson Company
Philadelphia, Pa.

A CASE of applying electrochemical principles and processes to the solution of a problem which once seemed hopeless, leads me to present the following:

It was at one time necessary to build a waste-heat, single-effect evaporator of special design, but similar in principle to a vertical water-tube boiler. One of the requirements was that it should be made entirely of cast iron. The water tubes were electrically welded to the headers as can be seen in the accompanying illustration; but when the job was finished and the evaporator assembled, it was found that no vacuum could be built up, because nearly all the welds, although mechanically strong, were not airtight, due to the presence of many very fine capillary tubes produced by the electric arc.



Heating Unit of Waste-Heat Evaporator Showing Welded Cast-Iron Tubes

As the welding operations had been done under a special contract, it was up to the welder to seal the capillaries. Accordingly, he first attempted to do so by caulking; but after a week's work, he found his efforts futile. He then resorted to the clogging of the capillaries with rust by promoting oxidation in their walls, using for this purpose a more or less saturated solution of ammonium chloride. Upon testing the evaporator it was found that its leakage had not decreased to a noticeable extent.

Finally, the permanent remedy was applied. Around each of the welds, and concentric with the tubes, rings made out of round structural iron, $\frac{1}{4}$ in. in diameter, were placed. These rings were held in place and insulated by means of small pieces of rubber which were compressed between the iron rings and the projecting ends of the tubes. The rings were then interconnected by means of copper wire and a watertight wooden cover was bolted to the flange. A piece of copper wire connected to the rings was made to pass through a rubber stopper which fitted a hole in the wooden cover.

An electrolyte made up of ferrous chloride, calcium chloride and water was then poured into the tubes and in such an amount as entirely to keep immersed in it all of the iron rings and welds. The electrolyte was kept as hot as possible by means of a steam coil.

The electric welding machine was then adapted for electrolytic work by inserting in the magnetic field of the generator a slide-wire resistance. This was done in order to reduce the voltage at the terminals of the generator so as to limit the current to a density of 15 to 20 amp. per square decimeter, calculated on the effective surface of the iron rings.

The positive terminal of the generator was then connected to the copper wire coming from the iron rings and the negative terminal to the evaporator. After 24 hours of electrodeposition of iron on the welds, the evaporator was tested and the maximum expected vacuum was obtained. It is thought that a similar procedure may be found useful in other cases.

PATENTS ISSUED

June 3 to June 24, 1930

Pulp, Paper and Glass

Process of Manufacture of Pulp and Paper. Levis Miller Booth, Plainfield, N. J.—1,761,069.

Apparatus for and Process of Separating or Extracting Cellulose or Paper Pulp. Edmondson Spencer, Calcutta, British India.—1,761,543-4.

Water-Resistant Paper. George James Manson, Hawkesbury, Ontario, Canada.—1,762,928-31.

Glassware-Annealing Leer. Albert N. Cramer, Toledo, Ohio, assignor to Owens-Illinois Glass Company, Toledo, Ohio.—1,763,223.

Sulphite Waste-Liquor Product and Process of Making Same. Webster E. Byron Baker, York Haven, Pa.—1,764,600-01.

Condensate-Removal Device for High-Speed Paper Driers. Arthur E. Broughton, Minneapolis, Minn.—1,764,713.

Apparatus for Making Composite Glass. John H. Fox and William Owen, Pittsburgh, Pa., assignors to Pittsburgh Plate Glass Company.—1,765,829.

Pulp-Stock Vat. Howard Parker, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,766,000.

Manufacture of Pulp. Francis G. Rawling, Chillicothe, Ohio, assignor to Mead Pulp & Paper Company, Dayton, Ohio.—1,766,944.

Process of Bleaching Cellulose Products. Ralph H. McKee, Jersey City, Earle H. Morse, Nutley, and Philip Edward Rollhaus, East Orange, N. J., assignors to Pilot Laboratory, Inc., Arlington, N. J.—1,767,543.

Rubber, Rayon and Plastics

Method of Coating Rubber with Cellulosic Derivatives. Herman Alexander Bruson, Philadelphia, Pa., assignor to Resinous Products & Chemical Company.—1,761,813-4.

Composition of Matter Comprising Resins and Rubber in Aqueous Dispersion and Method of Making the Same. Arthur Biddle, Trenton, N. J., assignor to United Products Corporation of America.—1,762,152-3.

Composition of Matter. William Beach Pratt, Wellesley, Mass., assignor, by mesne assignments, to Dispersions Process, Inc., Dover, Del.—1,762,194.

Making Condensation Products of Urea and Aldehyde. Kurt Ripper, Vienna, Austria, assignor to Fritz Pollak, Vienna, Austria.—1,762,456.

Process of Treating Rubber Latex and Product Thereof. William B. Wescott, Boston, Mass., assignor to Rubber Latex Research Corporation, Boston, Mass.—1,762,494.

Laminated Glass. Henry A. Gardner, Washington, D. C.—1,762,513.

Process for Vulcanizing Rubber and Products Obtained Thereby. Winfield Scott, Nitro, W. Va., assignor to Rubber Service Laboratories Company, Akron, Ohio.—1,762,531.

Method of Treating Latex and Product Obtained Thereby. John McGavack, Jackson Heights, N. Y., assignor to the Naugatuck Chemical Company, Naugatuck, Conn.—1,762,729.

Process of Spray-Drying Cellulose Acetate Solutions. Cyril J. Staub, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,762,937.

Rubber Composition and Method of Preserving Rubber. Harold Walter Elley, Wilmington, Del., assignor to E. I. duPont de Nemours & Company, Wilmington, Del.—1,763,293.

Machine for Dissolving Cellulose Xanthate and the Like. Richard Thurm and Eugene Schmierer, Saginaw, Mich., assignors to Baker Perkins Company, Inc., White Plains, N. Y.—1,763,379.

Antioxidant or Age Retarder. Albert M. Clifford, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,763,579.

Method of Vulcanizing Caoutchouc and the Product Derived Therefrom. Lorin B. Sebrell, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,763,619.

Process of Making Acetylcellulose. Henry A. Gardner, Washington, D. C.—1,764,204.

Manufacture of Cellulose Derivatives. Walter Hamis Glover, Leamington, and Claude Diamond, Coventry, England, assignors to Courtaulds, Ltd., London, England.—1,763,428.

Method of Coating Material. Earl C. Hall, Chicago, Ill., assignor to Western Electric Company, Inc., New York, N. Y.—1,764,625.

Process for the Preparation of Bodies from Acidyl Celluloses. Emil Hubert, Ludwig Lock, and Otto Leuchs, assignors to I. G. Farbenindustrie, Frankfort, Germany.—1,766,822.

Plastic Composition. William Hoskins, Chicago, Ill.—1,764,839.

Process of Producing Resins. Jacque C. Morrell and Gustav Egloff, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,766,927.

Manufacture of Condensation Products from Olefines and Naphthalene Hydrocarbon Compounds. Richard Michel, Uerdingen, assignor to I. G. Farbenindustrie, Frankfort, Germany.—1,767,302.

Process of Treating Cellulose to Produce Vulcanized Fiber and the Like. Robert R. Fulton, Wilkinsburg, Pa., assignor to Koppers Company.—1,767,662.

Solid Resinous Condensation Product. Willy O. Herrmann and Hans Deutsch, assignors to Consortium Für Elektrochemische Industrie G. m. b. H., Munich, Germany.—1,767,759.

Condensation Products of the Benzanthrone Series and Process of Making Same. Georg Kalischer, Heinz Scheyer, Paul Nawiasky, and Emil Krauch, assignors to General Aniline Works, Inc., New York, N. Y.—1,768,071.

Method of Making Pyroxylin Solutions of Low Viscosity. Harold Hibbert, Montreal, Quebec, Canada, and John L. Parsons, Erie, Pa., assignors to Hammermill Paper Company, Erie, Pa.—1,768,253.

Process and Apparatus for Treating Hydrocarbon Oils. Reginald K. Stratford, Sarnin, Ontario, Canada, assignor to Standard Oil Development Company.—1,768,342.

Petroleum Refining and Products

Process for the Regeneration of Aluminum-Chloride Sludge. Ernest B. Phillips, East Chicago, Ind., and James G. Stafford, Chicago, Ill., assignors to Sinclair Refining Company, Chicago, Ill.—1,760,962.

Process of Distilling Oil. Arthur E. Pew, Jr., Bryn Mawr, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,761,153.

Apparatus for Contacting Vapors with Solids. Walter Miller, Ponca City, Okla., assignor to Gray Processes Corporation, Newark, N. J.—1,761,270.

Process of Purifying Lubricating-Oil Distillates. Marvin L. Chappell, Watson, Calif., assignor, by mesne assignments, to Richfield Oil Company of California, Los Angeles, Calif.—1,761,328.

Art of Cracking Hydrocarbons. Eugene C. Herthel, Chicago, Ill., assignor to Sinclair Refining Company, New York, N. Y.—1,761,340.

Process for Treating Petroleum Oil. Carbon P. Dubbs, Wilmette, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,761,622.

Cracking Still and Process. Milon J. Trumble, Los Angeles, Calif.—1,762,433.

Carbonaceous Material and Process of Making the Same. Alfred Oberle, Oak Park, Ill.—1,763,101-2.

Method of Revivifying Fuller's Earth and Other Filtering Clays. Hugh Lowery, Alton, Ill., assignor to Standard Oil Company, Whiting, Ind.—1,763,167.

Vacuum System of Oil Conversion. Audley E. Harnsberger, Chicago, Ill., assignor to Pure Oil Company, Chicago, Ill.—1,763,604.

Apparatus for Treating Hydrocarbon Oils. Joseph B. Weaver, Chicago, Ill., assignor, by mesne assignments, to Gyro Process Company.—1,763,608-9.

Method for the Lye Treatment of Petroleum Oil. Charles K. Parker, Richmond, Calif., assignor, by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,764,117.

Oil-Vapor Separation and Condensation. John E. Bell, Brooklyn, N. Y., assignor to Foster Wheeler Corporation, New York, N. Y.—1,764,190.

Method and Apparatus for Treating Hydrocarbons. Richard Fleming, Plainfield, N. J.—1,764,296.

Process of and Apparatus for Distilling and Cracking Hydrocarbon Oils. David E. Day, Los Angeles, Calif.—1,764,391.

Conversion of Heavy Hydrocarbon Oils into Light Hydrocarbon Oils or Spirits. Frederick Lamplough, Middlesex, England.—1,765,167.

Process for Converting Oil. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,765,663.

Process of Cracking Petroleum Oils. Ralph A. Halloran and Archie L. Strout, Berkeley, Calif., assignors, by mesne assignments, to Universal Oil Products Company, Chicago, Ill.—1,765,976.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, and Louis T. Monson, Maplewood, Mo., assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,766,057-67.

Process for Breaking Petroleum Emulsions. Melvin De Groote, St. Louis, and Louis T. Monson, Maplewood, Mo., assignors to Wm. S. Barnickel & Company, Webster Groves, Mo.—1,766,112.

Retort for Distilling Oil Shale and the Like. Magnus Rudolf Kraul, Portland, Ore.; Anna E. Kraul administratrix of said Magnus R. Kraul, deceased.—1,766,132.

Process of Cracking Oil. Jean DeLattre-Seguy, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,766,246.

Continuous Treatment of Hydro-Carbons with Sulphur Dioxide. Guiseppe Cattaneo, Hilversum, Netherlands, and Paul Jodeck, Berlin, Germany, assignors to Allgemeine Gesellschaft für Chemische Industrie m.b.H., Berlin, Germany.—1,766,281.

Process and Apparatus for Cracking Oil. Gustav Egloff, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,766,331.

Method of Refining Liquid Hydro-Carbons. John Johnston, Jr., Escondido, Calif., assignor of one-half to James R. Townsend, Los Angeles, Calif.—1,766,338-9.

Process for the Destructive Distillation of Petroleum Oil. Aubrey D. David, Chicago, Ill., assignor to Universal Oil Products Company, Chicago, Ill.—1,766,983.

Continuous Low-Temperature Process and Apparatus for Treating Hydro-Carbons. William L. Gomory, Chicago, Ill., assignor to Standard Oil Development Company.—1,767,283.

Process of Coking Oils. Daniel R. Weller and Louis Link, Baton Rouge, La., assignors to Standard Oil Development Company.—1,767,331.

Sulphonic Compound and Process of Making the Same. Louis Burgess, Jersey City, and Hyym E. Buc, Roselle, N. J., assignors to Standard Oil Development Company.—1,767,344-5.

Process and Apparatus for Cracking Petroleum Oil. Jacque C. Morrell and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,767,695.

Emulsions from Partially-Oxidized Petroleum Wax and Process of Making the Same. Arthur W. Burwell, Niagara Falls, N. Y., assignor to Alox Chemical Corporation, New York, N. Y.—1,768,523.

Process and Apparatus for Treating Oils. Gustav Egloff and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,767,839.

Coal Processing and Products

Making Producer Gas. March F. Chase, Ardsley-on-the-Hudson, and Frederic E. Pierce and John Skogmark, New York, N. Y., assignors to Cos Process Company, Inc., New York, N. Y.—1,761,384.

Process for Making Combustible Gas. William W. Odell, Minneapolis, Minn., assignor to Columbia Engineering and Management Corporation, Cincinnati, Ohio.—1,762,100.

Gas Washer. Henry Kreisinger, Piermont, N. Y., assignor to International Combustion Engineering Corporation, New York, N. Y.—1,762,338.

Process for Making Carbonaceous Material. Alfred Oberle, Oak Park, Ill.—1,763,063.

Coking Retort Oven. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,764,065.

Coking Retort Oven. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,764,496-7.

Water-Gas Apparatus. Charles S. Chris-

man, West Chester, Pa., assignor to the U. G. I. Contracting Company, Philadelphia, Pa.—1,767,579.

Organic Processes

Method of Stabilizing Aldehydes. Marion C. Reed, Akron, Ohio, assignor to B. F. Goodrich Company, New York, N. Y.—1,763,326.

Manufacture of Acid Extracts, Alcohols, and the Like from Gas or Vapor Mixtures. Eugene C. Herthel, Chicago, Ill., assignor to Sinclair Refining Company, New York, N. Y.—1,761,341.

Production of Hydrocyanic Acid. Paul T. Dolley, Los Angeles County, Calif., assignor to California Cyanide Company, Inc., New York, N. Y.—1,761,433.

Process for Manufacturing Absolute Alcohol. Russell B. Crowell, Agnew, Calif., assignor to American Solvents & Chemical Corporation, New York, N. Y.—1,761,779.

Manufacture of Urea. Wilhelm Meiser, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie, Frankfort, Germany.—1,761,893.

Process for the Solvent Extraction of Woods. Arthur D. Little, Brookline, Mass., assignor to Arthur D. Little, Inc., Cambridge, Mass.—1,762,785.

Process of Recovering Resorcinol. Ivan Gubelmann and Clyde O. Henke, South Milwaukee, Wis., assignors to Newport Company, Carrollville, Wis.—1,762,979.

Method of Accelerating and Improving Tanning Processes. Friedrich Pospiech, Dresden, Germany, assignor to Chemische Fabrik Pott & Company, Dresden, Germany.—1,763,368.

Process for the Dehydration of Impure Ethyl Alcohol. Eloi Ricard, Melle, France, assignor, by mesne assignments, to U. S. Industrial Alcohol Company, New York, N. Y.—1,763,722.

Apparatus for Subjecting Materials to the Action of Indirect Heat. McGarvey Cline, Jacksonville, Fla., assignor to Wood Process Company, Inc., Eastport, Fla.—1,763,758.

Esters of Phthalic Acid. Alphons O. Jaeger, Crafton, Pa., assignor to Selden Company, Pittsburgh, Pa.—1,764,022.

Oxidation of Fluorene. Alphons O. Jaeger, Crafton, Pa., assignor to Selden Company, Pittsburgh, Pa.—1,764,023.

Purification of Crude Anthracene. Robert Ames Norton, Crafton, Pa., assignor to Seldon Company, Pittsburgh, Pa.—1,764,-031.

Process for the Manufacture of Acetic Acid. Robert H. Van Schaack, Jr., Evanston, and Robert Calvert, Wilmette, Ill., assignors to Van Schaack Bros. Chemical Works, Inc., Chicago—1,765,318.

Process of Chlorinating Saturated Hydrocarbons. Ralph H. McKee and Carroll M Salls, New York, N. Y.—1,765,601.

Process of Making Sulphuryl Chloride Ralph H. McKee and Carroll M. Salls New York, N. Y.—1,765,688.

Process for Separating and Purifying Sulpho-Acids of High Molecular Weight. Grigori Petroff, Moscow, Union of Soviet Socialist Republics.—1,766,304-5.

Condensation Products of Hydrogenated Naphthalenes with Ethylene. Richard Michel, Krefeld, Germany, assignor to I. G. Farbenindustrie, Frankfort, Germany.—1,766,344.

Production of Lactic Acid and Its Derivatives. Martin Luther, Mannheim, and Hans Beller, Oppau, assignors to I. G. Farbenindustrie, Frankfort, Germany—1,766,-715.

Castor-Oil Soap and Process of Making Castor-Oil Soap. Wyly M. Billing, Cincinnati, Ohio, assignor to Wm. S. Merrell Company, Cincinnati, Ohio.—1,767,041.

Carbonyl Compound and Process of Preparing the Same. Stephen A. Kiss, Bayonne, N. J., assignor to Standard Oil Development Company.—1,767,291.

Method of Preventing Polymerization of Vinyl Compounds and Reaction of Same with Aldehydes. Kenneth G. Blaikie, Shawinigan Falls, Quebec, assignor to Canadian Electric Products Company, Montreal, Canada.—1,768,434.

Production of Phosphoric Esters of Aliphatic Alcohols. Fritz Nicolai, Ludwigshafen, assignor to I. G. Farbenindustrie, Frankfort, Germany.—1,766,720-1.

Inorganic Processes

Manufacture of Concentrated Fertilizer Material. Herbert H. Meyers, Pittsburgh, Pa., assignor to Armour Fertilizer Works, Chicago, Ill.—1,760,990.

Process of Producing Titanium Oxide. Ralph M. Palmer, New York, N. Y.—1,760,992.

Method of Producing a Mixed Manure Containing Phosphoric Acid and Nitrogen. Frans Georg Liljenroth, Stockholm, Sweden.—1,761,400.

Purification of Zinc Sulphate Liquors. Oscar A. Fischer, Denver, Colo., assignor to R. H. Channing, Jr., agent, San Francisco, Calif.—1,761,782.

Apparatus for Manufacturing Acid Phosphate. Beverly Ober, Baltimore, Md., assignor to G. Ober & Sons Company, Baltimore, Md.—1,761,992.

Cementitious Product and Process of Obtaining Same. Robert A. Marr, Norfolk, Va., assignor to Ramar Syndicate, Inc., Norfolk, Va.—1,762,481.

Process of Preparing Zinc Dust and Apparatus Therefor. Harry A. Grine, Clarksburg, W. Va., assignor, by mesne assignments to Grasselli Chemical Company, Cleveland, Ohio.—1,762,716.

Method of Making Cuprous Compounds. Sheldon B. Heath and Merlin O. Keller, Midland, Mich., assignors to Dow Chemical Company, Midland, Mich.—1,763,781.

Apparatus for Dissolving Silicate of Soda. Lloyd B. Edgerton, Narberth, Pa., assignor to Philadelphia Quartz Company, Philadelphia, Pa.—1,763,845.

Refractory Product. Sandford S. Cole, Pittsburgh, Pa., assignor to Koppers Company.—1,763,882.

Process and Apparatus for Concentrating Sulphuric Acid. Franklin E. Kimball, Watson, Calif.—1,764,210.

Process for the Manufacture of Sulphuric Acid of High Purity. Henry Howard, Cleveland, Ohio, assignor by mesne assignments to Grasselli Chemical Company, Cleveland, Ohio.—1,764,309.

Process of Making Aluminum Chloride. Henry Blumenberg, Jr., Moapa, Nev.—1,-764,501-2.

Mining of Sulphur. Robert Holden Stewart, Vancouver, British Columbia, Canada, assignor to Texas Gulf Sulphur Company, New York, N. Y.—1,764,528.

Method of Generating Hydrochloric-Acid Gas. George P. Adamson, New York, N. Y., assignor to General Chemical Company, New York, N. Y.—1,764,593.

Hypochlorite in Colloidal Form and Process of Making the Same. Paul R. Hershman, Chicago, Ill., assignor to C. O. Sethness, C. H. Sethness, and Paul Rudnick, Chicago, Ill.—1,765,013.

Barium Sulphate and Method of Making Same. James B. Pierce, Jr., Charleston, W. Va.—1,765,737.

Production of Ammonia. Louis Cleveland Jones, Greenwich, Conn., assignor to Chemical Engineering Corporation, New York, N. Y.—1,765,534-5.

Synthetic Production of Ammonia. Ralph S. Richardson, Teaneck, N. J., assignor to Chemical Engineering Corporation, New York, N. Y.—1,765,541.

Apparatus for Producing Nitrogen. Wallace B. Van Arsdel, Berlin, N. H., assignor to Brown Company, Berlin, N. H.—1,765,-781.

Purification of Gases. Alphons O. Jaeger, Chicago, Ill., and Johann A. Bertsch, St. Louis, Mo.; said Jaeger assignor to Selden Company, Pittsburgh, Pa.—1,765,869.

Pigment Having Insecticidal and Fungicidal Properties and Process of Making Same. Edward A. Taylor, Cleveland, Ohio, assignor to Grasselli Chemical Company, Cleveland, Ohio.—1,766,412.

Stable Ammonium Bicarbonate. Erich Dehnel, assignor to I. G. Farbenindustrie, Frankfort, Germany.—1,766,705.

Production of Calcium Nitrate, Alumina, and Phosphorus. Robert Griessbach, Otto Schliephake and Otto Heusler, assignors to I. G. Farbenindustrie, Frankfort, Germany—1,766,785.

Process of Making Alkali-Metal Sulphydrates. Harry P. Bassett, Cynthiana, Ky.—1,766,810.

Process and Composition for the Generation of Chlorine. Gerald J. Howitz, New York, N. Y., assignor of one-half to Le Roy Seidell, Plainfield, N. J.—1,767,676.

Process for the Manufacture of Ammonia. Charles Urfer, Geneva, Switzerland, assignor to Société D'Etudes Minières et Industrielles, Paris, France.—1,767,780.

Method and Apparatus for the Manufacture of Salt. William F. Downing, Jr., St. Clair, Mich., assignor to Diamond Crystal Salt Company, St. Clair, Mich.—1,768,399.

Absorption of Gasoline from Natural Gas. Eugene E. Ayers, Jr., Swarthmore, Pa., assignor to B. A. S. Company, Philadelphia, Pa.—1,768,521.

Chemical Engineering Processes and Equipment

Mixer. John Johnson, Maplewood, N. J., assignor to Turbo-Mixer Corporation, New York, N. Y.—1,757,197.

Centrifugal Pump. Clarence G. Wood, Muncie, Ind., assignor, by mesne assignments, to Auto Prime Pump Company, Cleveland, Ohio.—1,757,281-2.

Multidisk Suction Filter. Victor C. Benjamin and Paul W. Prutzman, Los Angeles, Calif., assignors to Contact Filtration Company, San Francisco, Calif.—1,757,355.

Method of Producing a Coating Stable toward Acids and Alkalis on Metallic Articles. Fritz Ahrens, assignor of one-half to Harzer Achsenwerke, G. m. b. H., Bornum-on-the-Harz, Germany.—1,758,420.

Vacuum Dispersion Coating Process. Wilhelm Anton Franz Pfanhauser, Leipzig, Germany, assignor to Gesellschaft für Elektrodenzerstaubung m. b. H., Bohlitz-Ehrenberg, Germany.—1,758,531.

Apparatus for Removing Dust from Gases or Vapors. Edoardo Michele Salerni, Paris, France, assignor to E. M. S. Industrial Processes Limited, London, England.—1,758,624.

Method and Apparatus for Obtaining Solids from Liquids. Arthur B. Jones, Plainfield, N. J., assignor to Industrial Associates, Inc., New York, N. Y.—1,758,745.

Kiln for the Manufacture of Fused Cement. Antoine Bauchère and Gabriel Arnou, Paris, France.—1,758,778.

Wood Preservation. Howard S. McQuaid, Lakewood, Ohio, assignor to Harold W. Walker, Edgewood, Md.—1,758,958.

Heat Interchanger. Ralph G. Mansfield, La Salle, N. Y., assignor to Union Carbide Company.—1,759,126.

Centrifugal Scrubber. Paul M. Kuehn, Baltimore, Md., assignor to Bartlett Hayward Company, Baltimore, Md.—1,759,315.

Centrifugal. Carl Schaum, Germantown, Pa., assignor to Fletcher Works, Inc., Philadelphia, Pa.—1,760,286.

Material Agitation. Russell J. Pepper, Kenmore, N. Y., assignor to National Aniline & Chemical Company, Inc., New York, N. Y.—1,760,374.

Bow-Tube Film Type Evaporator. Russell C. Jones, Bronxville, N. Y., assignor to Griscom Russell Company, New York, N. Y.—1,760,907.

Filter and Means for Controlling the Pulp Level Therein. Jasper A. McCaskell, Salt Lake City, Utah.—1,761,401.

Centrifugal Treatment of Substances. Laurence P. Sharples, Chester, Pa., assignor to Sharples Specialty Company, Philadelphia, Pa.—1,761,593.

Apparatus for Mixing Gaseous Fluids. Charles Prache, Paris, France.—1,761,799.

Grinding Cement Materials, Etc. Carl Pontoppidan, Copenhagen, Denmark, assignor to F. L. Smidth & Company, New York, N. Y.—1,762,241.

Process for Drying Liquid Materials. Dirk Jacobus Van Marle, Buffalo, N. Y., assignor to Buffalo Foundry & Machine Company, Inc., Buffalo, N. Y.—1,762,250.

Method of and Apparatus for Saturating Sheet Material. Lester Kirschbraun, Leonia, N. J., assignor by mesne assignments, to Patent & Licensing Corporation, Boston, Mass.—1,762,336.

Mixing Apparatus. Henry S. Beers, Westport, Conn., assignor to Turbo-Mixer Corporation, New York, N. Y.—1,762,950.

Liquid-Mixing Device. John S. Watts, West Chester, Pa.—1,763,335.

Process for Hardening Colloids. Alfred Miller, Dessau, Germany, assignor, by mesne assignments, to Agfa Ansco Corporation, Binghamton, N. Y.—1,763,533.

Process for Preparing Contact Mass. Kenneth B. John, Wilmington, Del., and Carl W. Coslow and Christian J. Schwindt, Pittsburgh, Pa., assignors to Selden Company, Pittsburgh, Pa.—1,764,024.

Apparatus for Automatically Determining and Recording the Specific Gravities of Fluids. Harry A. Hurley, Los Angeles, Herbert J. Jones, Fullerton, and Honorato Jimenez, Los Angeles, Calif.—1,764,103.

Process of Recovering Grease from Garbage. Walter D. Cleary, Brooklyn, N. Y., assignor to De Laval Separator Company, New York, N. Y.—1,764,390.

Tunnel Kiln. Paul A. Meehan, Cleveland, Ohio, assignor to American Dressler Tunnel Kilns, Inc., Cleveland, Ohio.—1,764,460.

Mixing and Discharging Apparatus. Henry S. Beers, Westport, Conn., assignor to Turbo-Mixer Corporation, New York, N. Y.—1,764,498.

Liquid and Gas Contact Apparatus. Roscoe P. Mase, Wilkinsburg, Pa.—1,765,-087.

Pulverizing Machine. Benjamin A. O'Neill, Minneapolis, Minn., assignor to Schutz-O'Neill Company, Minneapolis, Minn.—1,765,309.

Producing Nonturbulent Circulation of Liquids. Justin F. Wait, New York, N. Y., assignor to National Aniline & Chemical Company, Inc.—1,765,386.

Filter Press. Adolph F. Wendler, Buffalo, N. Y., assignor to National Aniline & Chemical Company, Inc., New York, N. Y.—1,765,389.

Neutralization of Acid Waste Waters. Aaron M. Hageman, and William L. Sullivan, Bloomfield, N. J., assignors to Westinghouse Lamp Company.—1,765,424.

Apparatus for Saturating Fibrous Material. August E. Schutte, Northboro, Mass., assignor to Flintkote Company, Boston, Mass.—1,765,777-8.

NEWS *of the* INDUSTRY

Nitrate Consolidation Makes Progress

NEGOTIATIONS are well advanced which probably will result in the consolidation of the nitrate industry of Chile into one huge company. The new company is to be called the "Compania Salitrera Nacional" or "Cosana." The capital of "Cosana" will be about $365,000,000. Of this, $182,550,000, or one-half, is to be issued to the Chilean government, and the other half is to be issued as required to take over the different nitrate companies which will be united.

It is understood that the Chilean government will deliver to Cosana about 150,000,000 acres of undeveloped nitrate lands with an estimated content of between 50,000,000 and 60,000,000 metric tons of sodium nitrate. Other nitrate lands in excess of this are to be reserved for the state, but may be delivered to Cosana at a comparatively small price per ton of nitrate available.

The state will remove the export duties on sodium nitrate and iodine. Cosana and its shareholders' dividends will be subject to Chilean income taxes, but information indicates that the rate will be a fairly low one.

As compensation for the loss of revenue resulting from the removal of export taxes, Cosana guarantees to the state as "dividends" on its shares and for income taxes the following sums:

1930	$22,626,200
1931	21,906,000
1932	19,472,000
1933	17,038,000

Cosana will assume as a first charge on profits all debts, debentures, and preferred shares of the nitrate companies which are still in business and will make a compromise with those companies having plants and nitrate grounds which they are unable to work. It is estimated that the total indebtedness of this nature is about $146,000,000, the annual charge on which, for interest and redemption, will be about $14,600,000 per annum. It is also proposed to raise about $24,500,000 by the issue of a preferred security as working capital for existing plants and about $58,500,000 for erecting two new plants, each to produce 700,000 tons of nitrate a year. It is estimated that the actual cost of building these two plants will be about $44,000,000 and that $14,500,000 will be for working capital. These new plants are expected to be producing by the end of 1932. The interest and amortization on them is estimated at $6,600,000 a year, so that the annual service charge on the total prior charge as above will amount to about $21,200,000.

It is understood that Cosana intends to concentrate the production of Chilean nitrate as far as possible into large plants. The Maria Elena plant has been in operation four years, but it has been only recently that the costs of production originally estimated for this plant have been attained. The new Pedro de Valdivia plant of the Lautaro Nitrate Company to operate the Guggenheim process is under construction. The capital for this plant was provided a year ago. It is reported that 2,300 workmen are employed in its construction and a large number of additional laborers are employed each month. A railway of about 30 kilometers in length connects this plant with the Maria Elena plant. The Pedro de Valdivia plant is expected to be in production by July, 1931, with a capacity of 700,000 tons per annum.

THE capital of Cosana, apart from the $229,000,000 prior charges referred to above, will amount to $365,000,000, of which half will be allotted to the Chilean government and the other half to the existing producers. Of the $182,500,000 to be allotted to producers, the projected law provides that up to $60,875,000 may be issued as 7 per cent cumulative preferred shares, with a redemption provision starting at a later date.

Producers exchanging assets and liabilities of their existing companies (except debts, debentures, and preferred shares, which become a prior charge) for shares in Cosana will have the option of taking either common or preferred shares, or part of each. The Anglo-Chilean and Lautaro companies are expected to take only the common shares. Terms have been agreed upon between the government and the boards of the various companies, representing about 90 per cent of the industry, and negotiations are proceeding with the remaining companies.

Aikman, Ltd., estimates the probable profits that may be made by Cosana during the next five years, after deducting the full service for the prior charges referred to above, as follows:

July, 1930-June, 1931	$19,500,000
July, 1931-June, 1932	24,400,000
July, 1932-June, 1933	31,700,000
July, 1933-June, 1934	39,000,000
July, 1934-June, 1935	43,800,000

Investigation of Methanol For Anti-Freeze Use

ANTICIPATING that methanol is likely to be largely used as an anti-freeze, government officials have instituted an investigation concerning the toxic properties of the synthetic product, with a view to drawing up recommendations for safe practice. Neither Dr. James M. Doran, Commissioner of Industrial Alcohol, nor any of his colleagues in the interdepartmental conference which met June 20 to consider measures for protecting the public health from exposure to methyl alcohol when used as cold weather protection for automobiles, contemplates federal regulation of the manufacture and distribution of this product but they are genuinely apprehensive concerning the hazard which its widespread use may create. They are hopeful, however, that with the co-operation of the manufacturers, the investigation undertaken by Dr. R. R. Sayers, chief surgeon of the Bureau of Mines by assignment from the Public Health Service, will suggest measures that will protect the public without restricting the legitimate use of methanol.

With reference to reports in the press that the conference will recommend to Congress the enactment of regulatory legislation next December, *Chem. & Met.* is advised by Commissioner Doran that no legislative action will be prompted by the federal authorities. There is some reason to believe, however, that unless co-operative measures are effectively applied, the sale and use of methanol will be restricted by state legislation and city ordinance. Dr. Doran expressed the belief that the state laws and regulations and factory codes which have been adopted in the past for the purpose of protecting the public against methyl alcohol are not comprehensive enough to cope with the increased output of the synthetic product.

It is anticipated that sufficient data will be produced by Dr. Sayers' investigation before the opening of cold weather so that recommendations for safe practice in handling methanol doubtless will be forthcoming by the time that the usual winter demand for anti-freeze solution sets in. The use of these safeguards will not be mandatory, as the federal government has no jurisdiction over the manufacture, distribution, and use of methyl alcohol as such.

Large Chemical Fertilizer Plant for Canada

THE Consolidated Mining & Smelting Company of Canada, Ltd., Trail, B. C., according to recent announcements, has embarked upon a program for the manufacture of ammonium sulphate, triple superphosphate, di-ammonium phosphate, and mono-ammonium phosphate. A large chemical fertilizer industry will be established at Trail, where provision will be made for removing from the smelter fumes their deleterious element and utilizing it in important synthetic chemical operations.

This first unit will produce 35 long tons of fixed nitrogen per day, equivalent approximately to 192 short tons of ammonium sulphate, or alternatively, 260 short tons a day of ammonium phosphate. Ammonium sulphate has 21 per cent of fixed nitrogen in its composition and ammonium phosphate 15 per cent. This production will go on 7 days a week and 52 weeks a year.

The total power consumption of the first unit will be 30,000 hp. An electrolytic hydrogen plant will account for 23,000 hp. of this. There will be a liquid-air plant for extracting pure nitrogen from the air. A synthetic ammonia plant will fix pure nitrogen and the hydrogen gases from the foregoing two plants into anhydrous ammonia, which will be stored under pressure.

Over 300 tons of acid will be produced daily by a contact sulphuric-acid plant, which will utilize the sulphur dioxide from the roaster gases. The Consolidated has already a 35-ton sulphuric-acid plant, which has been working on these gases by the contact process since January, 1929, and this has proved very satisfactory.

In addition to these plants there will be the auxiliary plants for conversion of the ammonia into ammonia sulphate, plants for making phosphoric acid by treating phosphate rock from the company's beds at Fernie with sulphuric acid, and plants to convert this phosphoric acid into fertilizers such as triple super-phosphate, mono-ammonium phosphate, and di-ammonium phosphate.

Two of these auxiliary plants, one manufacturing phosphoric acid and the other triple super-phosphate and mono-ammonium phosphate, will use processes developed by the Kunstdunger Patent Verwertung A.G. Prominent corporations using other processes developed by this company include Imperial Chemical Industries, Ltd., of Great Britain, the Montecatini Company of Italy, Establishment Kuhlmann in Belgium, Société de Saint Gobain of France, Bataafsche Petroleum Maatschappi of Holland, Kali Industrie and Gasverarbeitungs Gesselschaft of Germany, and Nippon Chisso Kabushiki Kaisha of Japan. These two plants at Trail, one producing 55 deg. Bé. phosphoric acid directly without evaporation from phosphoric rock and sulphuric acid, and the other reprocessing the phosphoric acid into triple superphosphate or mono-ammonium phosphate, will be designed, erected, equipped, and serviced by the Dorr Company.

Rosin Symposium at A.S.T.M. Meeting

FOURTEEN technical sessions featured the four-day meeting of the American Society for Testing Materials held at Atlantic City, N. J., June 24-27. While standardizing work, as shown by the reports of various committees, plays a prominent part in the activity of the society, the importance of research was emphasized by the fact that eighteen special monographs on research results were added to committee reports.

Prominent among the symposia was that on rosin held on June 27 with Dr. K. G. Mackenzie presiding. The report of Committee D-17, on naval stores, was submitted by F. P. Veitch, chairman of the committee. This was simply a progress report of the committee and recommended advancement to standard of the tentative method of test for the determination of toluol-insoluble matter in rosin. After approval of the committee report, Dr. Mackenzie opened a symposium on rosin.

The following papers were presented: "Rosin in Rosin Esters," by Stephen Babcock; "Rosin in Paints and Varnishes," by F. W. Hopkins; "Rosin as a Linoleum Component," by M. K. Bare; "Rosin in Rubber Goods and Reclaiming," by H. A. Winkleman and E. B. Busenburg; "Rosin in Disinfectants," by R. C. Roark; "Rosin in Rosin Oil," by V. E. Grotlisch; "Rosin in Core Oils," by Werner G. Smith; "Rosin in Cable-Impregnating Compounds," by J. P. Millwood.

At the business session K. G. Mackenzie, of the Texas Company, was elected president of the society, and Cloyd M. Chapman, consulting engineer, New York City, was selected as vice-president.

New Company to Control Hydrogenation Patents

PURSUANT to plans announced some time ago, Standard I. G. Company, the holding company for the patent rights of the Standard Oil Company of New Jersey and I. G. Farbenindustrie Aktiengesellschaft, of Germany, relating to hydrogenation, has transferred these patents for the United States to the Hydro Patents Company, a newly organized Delaware corporation.

The shares of Hydro Patents are held by the following United States oil refining interests: Atlantic Refining Company, Barnsdall Corporation, The Cities Service Company, Continental Oil Company, Mid-Continent Petroleum Corporation, Pure Oil Company, Shell Union Oil Company, Sinclair Refining Company, Skelly Oil Company, Standard Oil Company of California, Standard Oil Company of Indiana, Standard Oil Company of New Jersey, Standard Oil Company of New York, Standard Oil Company of Ohio, The Texas Company, Union Oil Company of California, Vacuum Oil Company.

The share holdings of all of these companies, including the Standard Oil Company of New Jersey, are in proportion to their crude running capacities, with a minimum holding of 500 shares. Control of these patent rights within the United States therefore passes to the prospective users of the process on a pro rata basis.

It is expected that the Hydro Patents Company may later offer licenses and perhaps additional stock to other oil companies desirous of using the process, particularly when and if the process shall have been so far developed as to be capable of profitable application in plants of smaller size than those which now seem the minimum. These questions, and all other questions with relation to the future policy of the company, however, remain to be determined by the stockholders.

New Building to Be Erected at Milwaukee for the A. O. Smith Corporation. It Will Be Used Solely for Research

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

THOUGH TARIFF making is by no means over with, the strengthened flexible clause just coming into action, the chemical industry so far is little affected. Applications before the Tariff Commission for rate relief in the chemical line are few. According to some experts, it is unlikely that many chemical items could be much helped or harmed even if changes were undertaken. However, it is well to watch closely for a while, in order to make the most of the situation now developing under the new flexibile provisions.

Flexibility is the power to raise or lower a rate by not more than 50 per cent. It has been with us for eight years in an ineffectual form. Now the Tariff Commission is remade with much broader power which doubtless will be exercised to produce rate changes on many important commodities. The Commission recommends the final rate, which the President can approve or veto, but cannot change. The purpose, as formerly, is to set a duty which will equalize domestic costs in the "principal market of the United States" with those of an identical or similar product from abroad laid down at the same point. What made flexibility a failure under the Fordney-McCumber Act, aside from politics, was that the Commission was forced to determine actual production costs on foreign goods.

THE new law makes it possible to use invoice or wholesale values as alternates. In addition, for both foreign and domestic determinations, the Commission can consider "other relevant factors which constitute an advantage or disadvantage in competition." This seems to give broad latitude.

These changes are by far the most important in the entire tariff, and show why flexibility can mean something this time. How it actually will be used will depend largely on the new commissioners, who have not yet been appointed as this is written. For a while they will have to go slowly and develop a procedure which will result later in vastly speeding up the course of investigations. It is estimated that a case can be run through in about three months instead of two years, as formerly, and that 50 to 100 decisions per year can be turned out instead of only about 10. Procedure for private requests may be of a quasi-judicial nature, making the applicants and other interested parties prove their case and using the Commission personnel to check and amplify rather than for original investigations. One factor which limits such a plan is the preponderance of requests from Congress, which are in effect orders to investigate. Besides, a big probe is under way to find out how the ad valorem rates, now based on foreign valuations, would look if converted to pay the same customs collections on domestic values.

All this is going to take time, and more requests are piling up, which is a reason why the industry should enter any of its applications for changes early, so that they will not have to wait indefinitely. So far, the Tariff Commission's chemical division has comparatively little work lined up under the flexible provision. The valuation investigation is quite a job, although more of the chemical schedule rates are on a specific or "per pound" basis rather than under ad valorem rates. In addition, a report is ordered on the cost per barrel of crude petroleum delivered to refineries along the Atlantic seaboard, as against the cost of oil from Lake Maracaibo, Venezuela. This will be

Tariff Changes on a Percentage Basis Affecting Items of Chemical Interest Whose 1928 Imports Exceeded $100,000

Paragraph	Item Chemical Schedule Increases	Value of 1928 imports, thousands of dollars	Actual or computed ad valorem rate (Per cent) 1922	1930
1	Acetic acid containing not over 65%	$645	14.15	25.94
	Formic acid	174	25.00	38.74
	Tartaric acid	575	18.87	25.17
	Stearic acid	226	13.28	25.00
12	Barium carbonate, precipitated	116	103.89	134.76
16	Calcium acetate, crude	316	Free	28.46
19	Casein	3,674	19.47	42.83
20	Whiting; dry, ground, or bolted	183	25.00	175.76
26	Diethylbarbituric acid, salts and compounds	190	25.00	30.61
31	Transparent cellulose sheets not over 0.003 in thick	509	25.00	45.00
37	Butyl acetate	702	25.00	53.34
41	Edible gelatin, value under 40c pound	438	35.63	42.33
	Inedible gelatin, value under 40c pound	124	27.73	35.30
	Value 40c or more per pound	692	28.41	34.61
	Glue, glue size, and fish glue value under 40c pound	798	37.25	48.00
48	Juice of lemons, limes, oranges, or other citrous fruits unfit for beverage purposes	183	Free	65.33
52	Wool grease containing over 2% fatty acids	203	20.48	40.95
52	Wool grease, medicinal, including adeps lanae under 40 pounds	104	11.36	34.00
53	Olive oil, weighing with container under 40 pounds	9,114	4054	51.35
54	Sesame oil, edible	668	Free	28.14
54	Soybean oil	777	40.52	56.73
65	Artists' colors in cakes, pans, or other forms not over 1½ pounds net weight	153	40.00	80.00
67	Precipitated barium sulphate	169	43.57	54.46
76	Vermillion reds containing quicksilver	128	21.10	26.37
77	Lithopone and other combinations or mixtures of zinc sulphide and barium sulphate containing 30% or more zinc sulphide	120	29.17	44.17
78	Potassium nitrate, refined	416	12.75	25.50
81	Sodium phosphate, except pyro, n.s.p.f.	440	22.31	33.46
	Sodium silicofluoride	125	25.00	42.93
83	Potato starch	609	49.45	70.64
90	Spirits of turpentine	171	Free	5.00
	Total increases for chemical schedule	24,392	30.24	47.00
	Decreases			
1685	Ammonium sulphate	1,662	12.67	Free
1611	Argols, tartar, and wine lees containing under 90% potassium bitartrate	1,331	5.00	Free
1686	Chicle, crude	4,483	19.43	Free
1602	Licorice root	1,755	19.56	Free
1728	Ergot	297	10.08	Free
47	Licorice extracts in pastes, rolls, etc	215	25.00	20.00
51	Camphor; synthetic	822	16.74	13.95
	Natural refined	591	11.76	9.80
1732	Rapeseed oil	1,504	8.97	Free
58	Eucalyptus oil	120	25.00	15.00
78	Potassium chlorate	417	64.58	43.05
1754	Santoin and salts thereof	218	0.63	Free
	Total decreases for chemical schedule	14,940	17.06	3.54
	Total for chemical schedule	94,753	29.22	31.40
	Earths Schedule Increases			
201	Brick	450	Free	5.53
202	Tiles	1,336	47.85	57.08
205	Portland, Roman, and other hydraulic cement	3,091	Free	16.86
207	Fluorspar	410	57.96	84.82
	Crude feldspar	225	Free	12.38
208	Mica items	523	21.91	31.43
209	Talc, steatite, etc. except toilet preparations	470	25.00	35.00
211–212	China and crockery	16,625	60.15	70.46
213	Graphite items	694	24.82	32.54
216	Electric light carbons	115	45.00	58.50
218–230	Glass items	15,423	54.35	64.79
234	Granite items	485	29.55	37.52
	Total increases for earths schedule	39,979	49.86	61.06
	Total decreases for earths schedule due almost wholly to grindstones and burrstones	125	7.04	4.41
	Total for earths schedule	52,374	45.62	53.62
	Sugar Schedule Increases			
501	Sugar: under general tariff	1,335	78.99	88.03
	from Cuba	159,937	72.59	82.33
502	Blackstrap molasses: under general tariff	1,363	4.53	4.98
	from Cuba	8,523	3.68	4.04
	Total for sugar schedule	174,760	67.85	77.21
	Agricultural Schedule Increases			
762	Flaxseed or linseed	17,579	22.50	36.57
	Soybeans	155	13.77	55.06
	Rayon Schedule			
	Increases	2,003	46.06	52.78
	Decreases	368	59.91	52.32
	Total for rayon schedule	11,426	52.68	53.62

resultless, as petroleum is on the free list and cannot be given a dutiable status except in a general tariff revision by Congress.

UNDER the flexible provision, the only chemical investigations requested are on para-chlormetacresol and ultramarine blue. Sugar and the sugar-refining differential, cement, and pulpboard in rolls are the only items of chemical interest entered in other schedules. Action on all these awaits the seating of the new Commission. Meanwhile, it is time to be thinking what the industry could gain by rate readjustments by a presumably impartial survey—not perfect, because there is no tariff which will suit everybody, but at least more rational than a political revision. There are strong indications that the changes are going to take a downward trend, particularly on such agricultural items as are obviously too high under 1930 rates. This might help chemical manufacturers by cutting raw material rates—flaxseed and castor beans, perhaps. Rates on manufactures in general are at a fairly stable level. Formic acid and acetic anhydride seem too low. Casein possibly is too high. It would be highly speculative just what the Commission might do too in any definite instance, and thus it seems wise to hold off on doubtful requests till it is more evident how the procedure is shaping.

Aside from the flexible powers, the tariff administrative and special sections have been changed in many important instances. In general, entry of goods is made much easier for shipper, carrier, importer, and collector alike. The law has been weakened in that the Treasury Department no longer can embargo goods concerning which foreign exporters refuse access to records. Some think this will result in more falsifications, but it is expected to remove friction abroad.

Firms using sugar and non-ferrous metals in products for export trade can obtain drawback of duty more easily by the proviso that the raw materials imported may be interchanged with domestic supply. Formerly it was necessary to earmark the imported raw materials and put them through in special batches in order to get a refund of customs collections. Relief from this requirement is a great help to candy manufacturers and producers of lead products such as paint.

As for the rates, they still stand as tabulated in the April issue of *Chem. & Met.*, awaiting flexible changes. A more tangible idea of what has happened is given in the accompanying table based on Tariff Commission figures. Only the items of import significance are chosen, because these are the ones on which tariff means something, barring cases like rayon, where the new duties may protect against foreign competition which has not yet developed.

Muscle Shoals can be forgotten till next December when Congress reconvenes. So long as the conference committee remains in deadlock holding the conflicting bills, action probably will be blocked up to the end of the 71st Congress next March, when all old bills are off the slate and the weary process of legislation must begin anew. There is nothing to indicate that the House conferees will agree with the Norris government ownership plan or that the Senate will abandon it. The only concrete action lately has been the passage of two Senate resolutions introduced by Senators Black and Norris instructing the Secretary of War to lease some of the Muscle Shoals power to local municipalities on satisfactory application.

EXISTING regulations governing the administration of industrial alcohol will not undergo revision, with few exceptions, until Sept 1. New joint regulations issued by the Treasury Department and the Department of Justice July 9 are confined principally to changes incident to conferring jurisdiction upon the latter department, as provided in the Williamson law. Operative until a more elaborate revision of the permit system has been completed, the new regulations provide that no applications for the issuance and renewal of permits for more than 90 days calling for the withdrawal of more than 50 gal. of specially denatured alcohol monthly shall be approved by the supervisor of permits until after the prohibition administrator has had ten days within which to investigate. No permits may be issued in any case in which the administrator has expressed his intention to intervene. The same limitation applies to applications for withdrawal of more than 200 gal. of intoxicating liquor annually. Applications for the withdrawal of lesser amounts of either specially denatured alcohol or whiskey are excluded from the scope of such joint supervision.

The principal interest of the alcohol-using trades centers in the more or less detailed revision of the regulations that will be submitted to them for criticism in a few weeks. So far there is no indication that Amos W. W. Woodcock, Director of Prohibition, or his associates in the Department of Justice, intend to interfere with present administrative practice affecting the technique employed in the manufacture of products in which specially denatured alcohol is a necessary ingredient. Subject to the exercise of the veto power placed in the hands of the Department of Justice, the Bureau of Industrial Alcohol, under Commissioner James M. Doran, will retain the duty of issuing permits and supervising the activities of permittees.

THE prohibition districts have been reduced in number from 27 to 12 with boundaries roughly corresponding to the ten judicial circuits. The Department of Justice is represented by a prohibition administrator and the Treasury Department by a permit supervisor at headquarters in each district. This dual organization will permit close co-operation between the two departments and reasonably prompt action with respect to the issuance of permits, at the same time that it enables the administrator, charged with law enforcement, to maintain a constant scrutiny of permit activities under the immediate charge of the permit supervisor.

Of the appropriation of $13,500,000 made for the fiscal year which commenced July 1, approximately $9,000,000 has been allocated to enforcement and $4,500,000 to the supervision of permits. Reorganization of the personnel is still in process. Transfer of enforcement activities to the Department of Justice has not been attended by any big shake-up, but it is probable that considerable weeding out will occur in the ensuing month.

The chemical division of the Bureau of Foreign and Domestic Commerce is being represented at Chile's nitrate centennial by T. W. Delahanty, assistant chief of the division. With the rise of the Guggenheim process the nitrate industry is taking on an American complexion, with a corresponding decline in British influence.

Chemical Executives May Meet in November

In response to suggestions from the industry, a meeting of chemical executives, in November, is under consideration at the Commerce Department. An ambition is entertained to have this the first meeting in the auditorium of the new Commerce building, in Washington. The auditorium will seat 1,000 persons and will be equipped with a stage and every facility that can be used to advantage for conferences of this sort.

Dorr Fellowship at Mellon Institute

ANNOUNCEMENT has been made by the Dorr Company that it has established a fellowship to begin immediately at Mellon Institute, for research into one of the most important problems with which the company has to deal. For many years the Dorr Company has made use of coagulation and dispersion principles; in this way a considerable body of valuable information has been acquired, which the company has been able to apply to similar or even to entirely different problems as they arose. The fellowship just granted is for the purpose of inquiring into and establishing the theoretical laws governing coagulation and dispersion.

Dr. Franklin P. Lasseter will carry on this work at Mellon Institute. He is a graduate of Ohio State University and obtained his doctorate at Columbia. Dr. Lasseter has specialized in the manufacture of cement, with special emphasis on research on the chemistry of settling.

Technical and Industrial Meetings Interest German Chemists

Important Papers Read at Meeting of Verein Deutscher Chemiker

From Our Berlin Correspondent

DURING a month punctuated by important meetings and conventions, three were of special interest to chemical engineers: the meeting of the Verein Deutscher Chemiker at Frankfurt, the World Power Conference at Berlin, and the Achema, which is comparable to the American Chemical Exposition.

Anhydrous aluminum chloride, according to a lecture by C. Wurster, Ludwigshafen, is commercially produced by the I.G. in a variation of the method employed by McAfee and the Gulf Refining Company. Together with the late J. Brode, Wurster developed a continuous method which exploits the exothermic formation of aluminum chloride from aluminous clays, chlorine, and carbon monoxide (or coal), and hence needs no additional heating. The furnaces are protected against the reaction gases by a cold metal covering, while inside a refractory and chlorine-resistant cylinder of siliceous materials surrounds the reaction chamber. Counter-currently chlorine and monoxide are blown in. The system can be kept in uninterrupted operation, or without supplementary heating, for years. The product is 97 per cent aluminum chloride, in addition to 2.5 per cent ferric chloride and 0.5 per cent titanium chloride, whereas McAfee's product is said to contain only 94 per cent.

A new cyanide synthesis was reported by Henglein, Leverkusen, based on the interaction of carbon monoxide, ammonia, and soda. If finely divided soda is subjected to the action of the other two agents at 600 to 650 deg. C., a quantitative yield of sodium cyanide is obtained, while the gaseous mixture becomes richer in carbon monoxide and hydrogen. For commercial success a fine division of the gases and the melt is essential. After the reaction has begun and a gaseous mixture of carbon monoxide, ammonia, and carbon dioxide is present, ammonium carbonate is removed, the water is absorbed by drying agents, and the gases are returned to the cycle. If the quantity of hydrogen becomes too great, the mixture of carbon monoxide and hydrogen is used for heating and new mixtures of carbon monoxide and ammonia are employed.

A NEW method for the production of ammonium sulphate and nitrogen was pointed out by Vorländer, Halle. He found that the speed of oxidation of ammonium sulphite in air to sulphate is so greatly accelerated by a cobalt catalyst, that the reaction proceeds in very brief order without heating. The catalyst is a complex cobalt-ammonium-sulphite which, after completion of the oxidation, is returned to the reaction chamber together with water, ammonia, and sulphur dioxide, whereupon elemental nitrogen escapes.

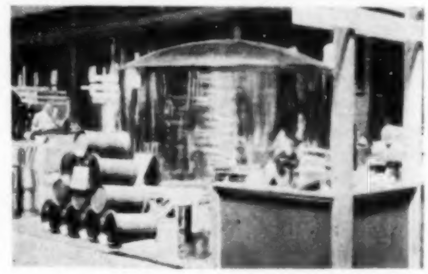
For purposes of industrial control, rather than commercial possibilities, a new method for the absorption of hydrogen is reported by F. Hein, Leipzig. While solutions of silver permanganate absorb nitrogen at ordinary temperature and pressure much more rapidly than saturated potassium permanganate, this velocity is so greatly increased by the addition of silver nitrate and silver in silica gel, that the reaction offers a very rapid control on hydrogen.

In the section on petroleum and liquid fuels, K. Peters, of the Mühlheimer Coal Institute, spoke of the synthesis of acetylene from methane. A 100 per cent efficiency seems scarcely possible, but even with only a 30 to 40 per cent efficiency such processes could compete with the carbide process. Of the three important methods, the arc process is not taken into consideration, because of its excessive carbon deposits. The second process, based on a purely theoretical principle, enabled Franz Fischer to synthesize benzol from methane by way of acetylene. However, in experiments on acetylene synthesis, by electric discharge in vacuum of $\frac{1}{10}$ to $\frac{1}{20}$ atmosphere, the utilization of the electric energy was brought up to 40 per cent of the theoretical value. The production of 1 cu.m. of acetylene from coke-oven gas by this process requires 12 to 13 k.w.h., so that the minimum necessary energy for the carbide process is already attained. If the starting gas is high in methane, a product is obtained that contains much hydrogen besides acetylene. In the use of a methane gas high in nitrogen, as in the case of coke-oven gas, a byproduct mixture of nitrogen and hydrogen or carbon monoxide and hydrogen is obtained. By washing the product with cool acetone the acetylene is easy to obtain pure.

Industrial Apparatus Hall, One of Four Exhibit Halls at Achema. Ammonia Oxidation Unit and Distilling Columns Loom in Rear

FOR cleaning and maintenance of a network of gas lines, Weissenberger, Berlin, has developed a tetralin process that protects the inside of pipe lines against corrosion. Tetralin is mixed with the gas in very small quantities, either by vaporization or as a cold mist. The injection of the tetralin, which should be as accurate as possible, requires special equipment which is built according to patents of Martini and Hünecke, G.m.b.H., Berlin. The tetralin not only dissolves all solid matter in the pipe lines but also absorbs iron hydroxide, binds the rust, prevents suspended dust, and renders further rust formation impossible.

Penthranit, the name of the new explosive mixture of solid penta-erythrite-texraitrate (penthrite) and liquid nitroglycerine, was discussed by its inventor, A. Stettbacher, Zurich. This mixture probably is the most powerful explosive for practical uses at the present time. Within the limits of 10 to 70 per cent penthrite and 90 to 30 per cent nitroglycerine, it exceeds the best freshly prepared blasting gelatine in destructive power.



Stainless Steel Digester Exhibited at Achema

The Exposition at Frankfurt was a success even beyond the usual visual and personal contact intended. Forty thousand visitors are estimated to have attended, but leading industrialists held lectures throughout the period which became available to non-visitors interested in chemical apparatus. The German Society for Chemical Apparatus (Dechema), which instituted the exhibition, is becoming more and more an integral part of industrial chemical enterprise in Germany. Although it recorded an unexpected number of sales, its intention remains primarily to give visual exhibition of installation and apparatus that deserve the attention of the industrial engineers.

In conclusion, it may be mentioned that lignite from the Rhine district increased its production in the last year to 52,340,000 tons (6.8 per cent increase), while briquet production increased by 4.92 per cent to 12,010,000 tons. Experiments on a 5-ton truck with gas from lignite briquets showed that, although fuel costs are considerably lower than with liquid fuel, it is nevertheless questionable if it will be possible to make gas-generation as flexible as the demand of a motor-truck will require.

French Chemical Trade in Slower Position

Consuming Demand Eased Off Since First of April

From Our Paris Correspondent

OWING TO the general slump in business, the situation of the French chemical industry, which up to now has been good, shows signs of uneasiness. The deficiency of the French commercial balance now reaches 8 billion francs and as the new American custom tariffs will certainly curtail French exports, prospects are gloomy. This is the main cause of the drop of French industrial shares, in spite of the favorable results obtained in 1929.

Chemical trade companies seldom give their shareholders dividends amounting to 3 per cent, 2½ per cent being the usual average, the policy of the board of managers being to invest a large portion of the firms' profits in working capital in order to avoid the heavy French state fiscal duties. A striking example of the heaviness of these fiscal duties may be shown by the taxes paid by the Kuhlmann Company, which, with a working capital of 312½ million francs, paid 42 million francs in fiscal duties in 1929, amounting roughly to the total amount of the shareholders' dividends during the same year.

The present industrial crisis in France is partly due to the unfavorable situation of home agriculture. Though the 1929 wheat and grape crops were abundant, the sales of corn, flour, and wine dropped markedly. Moreover, French agriculturists are now heavily handicapped by their French Algerian competitors on the home market. It should be noted that though Algeria is not a colony but part of France, customs duties are still levied on Algerian goods imported into Continental France, owing to the fact that labor is far cheaper in Algeria.

RECENTLY a bitter conflict between French and Algerian wine growers had to be arbitrated by the government, and a new bill will be discussed in Parliament, forbidding the planting of new vineyards in French territory, limiting the number of existing ones, and prohibiting the sale of all wines of inferior quality, which will have to be distilled and turned into industrial alcohol. Since the war most nations have had to deal with the same problem: a greater output and a stationary consumption. France is no exception to this rule, but, whereas the consumption of manufactured goods in France could be notably increased, the home consumption of agricultural products cannot, unless the population increases, and it does not.

A crisis is therefore liable to happen in French agricultural circles. This superabundance of agricultural products is due to the fact that the high price of labor and fertilizer has compelled farmers to cultivate fertile lands only where fertilizers give their best results. This method is proving efficient, as may be gathered by the following figures: the present corn field areas are 15 per cent smaller than 15 years ago but the harvests of 1929 and 1914 were identical.

Though the present consumption of nitrate and potash fertilizers may increase, phosphate fertilizers are not likely to follow suit. In 1923 the production of phosphate fertilizers reached 2,000,000 tons. It is slightly over 2,000,000 tons today, which proves that the limit of consumption has been reached.

The keen competition between manufacturers of fertilizers has now ceased. Prices having dropped almost below cost, arrangements were consummated between former competitors, and prices have risen, though not sufficiently to become remunerative. The consumption of sulphate of copper also dropped considerably last year; it is said the hard frost of last winter was responsible for this, as most of the vineyards' parasites died of cold and wine growers did not deem it necessary to use sulphate this year as extensively as they generally do.

There is no definite solution yet for the use of nitrogen as a fertilizer. At present the French output of nitrogen covers only part of the home consumption, and in spite of the drop in prices resulting from the agreements drawn between British, Chilean, and German manufacturers, the sale of nitrogen fertilizers and nitrates of calcium and ammonia has been good. Next year it is believed the home nitrogen production will cover all the home needs.

The most popular fertilizer in France is sulphate of ammonia, which is being extensively manufactured and needs large quantities of sulphuric acid. New sulphuric-acid factories are being built. The large quantities of sulphuric acid used in the manufacture of sulphate of ammonia compel manufacturers to find substitutes for fixing ammonia, such as gypsum. The Toulouse works in France and the Oppau works in Germany both use gypsum. Other processes also are being experimented with to fix ammonia, such as the gas sulphur process, but this yields good results only with coal gas; with coke-oven gas the results obtained are unsatisfactory.

The cyanamide industry has become prosperous in France and it now competes favorably with nitrogen fertilizers on the home market. In certain districts cyanamide fertilizers are preferred for their high content of calcium. The same high content of calcium accounts for the success of two new nitrogen fertilizers: nitrate of magnesia and a double nitrate of calcium magnesia containing from 14 to 15 per cent of nitrogen.

Consumption of urea obtained from cyanamide or by direct synthesis is very small in France, only 2,400 tons having been used in 1929. A new fertilizer called "phosphazot" is now being manufactured and exploited by a well-known firm. This product is made by the reaction of natural phosphate treated by sulphuric urea. Other firms manufacture ammonia superphosphates by neutralizing the phosphoric acid of superphosphates with ammonia. Generally speaking, the present tendency in the fertilizing industry is to combine or unite two or three fertilizing elements such as phosphorus, nitrogen, and potash, avoiding inert matters as much as possible.

Chemical Fraternity Holds Biennial Convention

APPROXIMATELY 120 members and guests of the chemical fraternity, Alpha Chi Sigma, participated in the biennial convention at Radisson Inn, near Minneapolis, Minn., on June 18 to 20. Representatives of 46 collegiate and 9 professional chapters of the organization were present. Officers selected for the coming biennium are Dr. Charles A. Mann, professor of chemical engineering, University of Minnesota, as national president; M. E. Dice, of the General Petroleum Corporation of California, as vice-president in charge of collegiate chapters; H. E. Wiedemann, consulting chemical engineer of St. Louis, as vice-president in charge of professional activities; Prof. Walter S. Ritchie, of the University of Missouri, as national master of ceremonies; and John Kuebler, of Indianapolis, as national secretary. The business offices of the fraternity will continue under Mr. Kuebler at 5503 East Washington Street, Indianapolis, Ind.

Sulphuric Acid Plant Under Construction in Ontario

IN a report from Charles W. Allen, vice-consul at North Bay, Ontario, it is stated that the sulphuric-acid plant under construction by Canadian Industries, Ltd., at Copper Cliff, for utilizing smelter fumes, will have space for four 50-ton per day acid units, of which three are to be installed at present. Niter cake production of 200 tons per day is planned with room for expansion. Sodium sulphate storage space is provided for 16,000,000 lb. This material is to be obtained from deposits in Saskatchewan operated by the Horseshoe Mining Company, a subsidiary of the International Nickel Company, whose large-scale activities in the Sudbury area involved a $40,000,000 expansion program over the past four years, and a further $10,000,000 expenditure is yet to be made in the development of the rich nickel copper and rare metal ores.

MEN IN CHEMICAL ENGINEERING

H. V. CHASE has been promoted to assistant director of operations, explosives department of the Hercules Powder Company. Mr. Chase had for two years previously been superintendent of the Kenvil (N. J.) explosives plant and before that was in charge of some of the smaller plants.

WILLIAM T. READ has resigned as head of the department of chemistry at Texas Technological College to accept appointment as dean of the newly organized school of chemistry at Rutgers University, New Brunswick, N. J. Dr. Read is a graduate of the University of Texas and received his further degree at Yale, where he was active for several years in the promotion of chemical engineering education before being called to his recent post in Texas. His new duties will be primarily in the line of organization of various chemical departments, among which chemical engineering is being emphasized, especially because of the strategic location.

ZAY JEFFRIES, consulting engineer of Cleveland, delivered the annual commencement address at the South Dakota State School of Mines and received an honorary degree of Doctor of Engineering. It was the twentieth anniversary of Doctor Jeffries' graduation from this institution.

ANDREW M. FAIRLIE, consulting engineer at Atlanta, Ga., has returned from a several months' trip to Europe, where he paid particular attention to the chamber of sulphuric-acid situation.

J. C. C. HOLDING, for four years manager of the American Stainless Steel Company, Pittsburgh, has been elected vice-president and manager of the company.

ELMER K. BOLTON, since 1915 a member in various capacities of the duPont Company, has been promoted to the post of chemical director, succeeding Charles M. A. Stine. Before Dr. Stine's election to a vice-presidency, Dr. Bolton was assistant director.

W. F. BRIMIJOIN has been appointed superintendent of the Kenvil Explosives Plant of the Hercules Powder Company to succeed H. V. Chase. He had been assistant superintendent under the latter at Kenvil since 1928.

FRANKLIN P. LASSETER, of Ohio State and Columbia universities, has been appointed to a new fellowship at Mellon Institute of Industrial Research, Pittsburgh, for the investigation of basic problems on hydro-industrial technique. The fellowship is being supported by the Dorr Company, which has specialized in the development of apparatus in this field.

LEO V. STECK, who was with Pike and West, chemical engineers at Emeryville, Calif., has taken charge of special development work for the Shell Development Company, also at Emeryville.

LEWIS DEBLOIS has resigned from the National Bureau of Casualty and Surety Underwriters and will enter a consulting practice, specializing in safety engineering, in New York. Mr. DeBlois was formerly of the duPont Company.

CHARLES B. CHATFIELD has left the U. S. Dispersions, Inc., to become assistant director of research of the Headley Emulsified Products, Inc.

CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, New Orleans, Dec. 8-10.

AMERICAN CHEMICAL SOCIETY, 80th meeting, Cincinnati, Sept. 8-12.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Detroit, Sept. 25-27.

AMERICAN PETROLEUM INSTITUTE, 11th annual meeting, Chicago, Nov. 10-13.

NATIONAL METAL CONGRESS, 12th annual meeting, Chicago, Sept. 22-26.

L. F. NICKELL, assistant vice-president of the Monsanto Chemical Works and manager of the Monsanto (Ill.) plant, has been elected chairman of the board of the Monsanto Chemical Company, Ltd., the English subsidiary, and will sail on Aug. 8 to take charge of affairs. His headquarters will be in London, where he succeeds John D. Gillis, who died recently. Dr. Nickell joined the parent company in 1917 and has headed its Monsanto (Ill.) plant since 1920. He was graduated from the University of Illinois in 1909, became Ph.D. there in 1913, and for a time was assistant professor of chemistry at Washington University, St. Louis.

HOMER H. LOWRY has been named director of the coal research laboratories of Carnegie Institute of Technology. Dr. Lowry comes from 10 years of work on the technical staff of the Bell Telephone Laboratories, New York, and will now partake in the five-year program of fundamental research on coal and coal products recently announced by Dr. Baker, president of the Institute.

HERMAN SHUBRING, until recently a research engineer in the employ of the Cooper-Bessemer Corporation, has joined the technical department staff of the Du Pont Ammonia Corporation, Belle, W. Va.

L. W. CHUBB has been appointed director of the Westinghouse Research Laboratories to fill the position left vacant by the promotion of S. M. Kintner to assistant vice-president.

O. E. HARDER has left the University of Minnesota to become assistant director of the Battelle Memorial Institute, Columbus, Ohio. He went to Minnesota in 1919 after industrial work on the catalysis of fat-hardening and on uranium.

KENNETH G. MACKENZIE, consulting chemist for the Texas Company, New York, was elected president of the American Society for Testing Materials at its meeting in Atlantic City, N. J., late in June. Mr. Mackenzie, who was graduated from Yale in 1907, spent several further years of education and

teaching there before entering industry. However, by 1911 he had joined the Texas Company as consulting chemist and has retained this connection ever since. He was president of the New York Chemists Club in 1925-26.

G. J. ESSELEN will withdraw from the firm of Skinner, Sherman & Esselen, Inc., Boston, on Aug. 1, after which the firm becomes Skinner & Sherman, Inc. Dr. Esselen will open his own laboratory in Boston for research and technical counsel.

WALTER L. TEPPER has been elected president of the Martin Rubber Company, Long Island City, N. Y., to take the place of Dr. Martin Tepper, who resigned to become chairman of the board. The new president has spent the past few years as general manager of the company and is an engineering graduate of Columbia University.

G. H. CUNNINGHAM has joined the San Francisco Mines of Mexico, Ltd., as consulting engineer on zinc plant investigation, a type of work similar to his recent electrolytic investigations for the American Smelting & Refining Company.

FREDERIC C. CLARK, South Manchester, Conn., has combined his consulting practice with the firm of Skinner & Sherman, Inc., Boston. He has been largely associated with the pulp and paper industry, having been chief of the paper section of the Bureau of Standards at Washington and manufacturing head of several companies.

ERNST R. HABICHT has been employed as research engineer in the technical department of the Du Pont Ammonia Corporation, Belle, W. Va. Mr. Habicht is a graduate from Harvard Engineering School and the Polytechnicum, Zurich, and until recently was with the Combustion Engineering Corporation.

RICHARD W. PLUMMER, formerly metallurgist for the Aluminum Company of America, has been added to the chemical department of the Du Pont Ammonia Corporation.

EDWIN C. ALFORD, formerly with the Struthers-Wells Company, has joined the Western Precipitation Company to engage in sales engineering work in connection with spray drying and dust collection.

OBITUARY

HARVEY W. WILEY, outstanding crusader for pure-food regulation, died at the age of 86 years at his home in Washington, D. C., on June 30. A review of the professional career of Dr. Wiley is virtually a résumé of the history of the enactment and the enforcement of pure-food legislation by the United States. His unique position in the public service has been strikingly recognized by the unusual permission granted by the War Department for the placing of a special monument over his grave in Arlington National Cemetery on which will be inscribed the words, "Father of the Pure-Food Law." Dr. Wiley was born in Kent, Ind., Oct. 18, 1844, and attended Hanover College, Indiana Medical College, and Harvard University. His early professional career was in teaching, from which he gradually entered a public career leading to chief chemist of the U. S. Department of Agriculture fron 1883 to 1912.

Underwood & Underwood

It was during this long period that he labored unceasingly for the enactment and as leader in the enforcement of the federal food and drug law. After his retirement from active government service Dr. Wiley continued in professional work as a writer and consultant—uninterrupted until late in 1929, when failing strength compelled him to retire from arduous activities. Only in the last few weeks of his life was he compelled to discontinue interest in the program of legislation and investigations in progress.

JOHN D. GILLIS, managing director of the Graesser-Monsanto Chemical Works, Ltd., died in London on June 24. Mr. Gillis was president of John T. Milliken & Company before joining Monsanto in St. Louis, and was chosen by the latter to head the English subsidiary early this year.

WILLIAM HENRY BRISTOL, inventor of numerous recording and control instruments and president of the Bristol Company, of Waterbury, Conn., died in New Haven on June 18 at the age of 70. A graduate of Stevens Institute of Technology in 1884, he spent many subsequent years teaching, but finally founded the Bristol Company in 1899 to disseminate his inventions commercially.

W. L. STEWART, president of the Union Oil Company of California since 1914, died at Hermosa Beach, Calif., on June 21 at the age of 62. Born in Titusville, Pa., he soon ventured to California but interrupted his practical experience there with three years at the University of California.

INDUSTRIAL NOTES

LUKENS STEEL COMPANY, Coatesville, Pa., is entering the manufacture of welded steel construction through a subsidiary known as Lukenweld, Inc., with G. D. Stackman as president.

GOSLIN - BIRMINGHAM MANUFACTURING COMPANY, Birmingham, Ala., has become affiliated with the Whiting Corporation, Harvey, Ill.

SUPERHEATER COMPANY has moved its offices to 60 East 42d St., New York.

B. F. STURTEVANT COMPANY of Boston, Mass., has removed its Minneapolis office to 874 Northwestern Bank Building.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., has transferred H. W. Petty to its Pittsburgh, (Pa.) office as branch sales manager.

PARTLOW CORPORATION, Utica, N. Y., has moved into larger quarters in a plant at New Hartford, near Utica.

CRANE COMPANY, with headquarters at Chicago, celebrated its 75th anniversary throughout its various offices and plants on July 3.

TOLHURST MACHINE WORKS, INC., becomes an independent company through the merger of the General Laundry Machinery Company and the American Laundry Machinery Company, with the former of which it was previously associated.

GENERAL REFRACTORIES COMPANY has moved its Detroit office to 2,328 Union Trust Building.

SWINDELL-DRESSLER CORPORATION, Pittsburgh, Pa., is the consolidation of William Swindell & Bros., American Dressler Tunnel Kilns, Inc., Duquesne Burner Service Company, and the Gas Combustion Company.

MAGNETIC MANUFACTURING COMPANY, Milwaukee, Wis., has appointed L. J. Byrne representative at 9 South Clinton St., Chicago.

CHICAGO PUMP COMPANY is now represented by R. J. Welch at 503 Healy St., Atlanta, Ga.

FREY STEEL PRODUCTS COMPANY has been organized with a plant at Milton, Pa., and an office at 620 Lewis Tower, Philadelphia, Pa. The Pearce Fireproof Company at Philadelphia is acting as distributor.

ALUMINUM COLORS, INC., Indianapolis, Ind., has been formed by purchase of all rights from the Metals Protection Corporation, and will have as officers M. L. Gould, president; Fred A. Wales, vice-president; and John D. Gould, secretary and treasurer.

CUTLER-HAMMER, INC., Milwaukee, Wis., have acquired the firm of Schweitzer & Conrad, Inc., Chicago, but will operate it as an independent manufacturing and selling unit.

FULLER LEHIGH CO., Fullerton, Pa., has opened a new sales office at Atlanta, Ga., under J. M. C. Hill.

LOUIS ALLIS COMPANY, Milwaukee, Wis., has opened offices at Union Bank Building, Pittsburgh, Pa., under C. O. Sargent; at 215 East Archer St., Tulsa, Okla., under W. Woobank; and 4,441 Santa Fe Ave., Los Angeles, Calif., under A. R. Thomas.

JENKINS BROTHERS, New York, has elected James R. White vice-president and director of sales.

HEVI DUTY ELECTRIC COMPANY is now located at its new plant at 4,100 Highland Blvd., Milwaukee, Wis.

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Chemical Production on Smaller Scale Last Month

Seasonal Influences and Desire to Reduce Inventories Restrict Operations

FOR SOME time, consumers of chemicals have pursued a policy of hand-to-mouth buying, and this has had the effect of slowing up activities on the producing end. Seasonal influences likewise have contributed to lessen the volume of consumer demand, and in order to avoid heavy surplus holdings, producers have restricted operations. The movement against contracts has been fairly steady and in some cases compares favorably with that of a year ago. Consumption of chemicals in general has been large, although the first half of this year is admitted to have fallen below the level of the corresponding period of last year. The outlet for chemicals in the oil-refining, fertilizer, soap, and insecticide trades has been very satisfactory, but most other consuming trades have fallen below their quota rate of 1929.

Latest available statistics for some of the branches of the chemical industry offer the following comparisons of activities:

Production

	May 1930	May 1929
Acetate of lime, 1,000 lb.	8,241	12,703
Methanol, crude, gal.	523,833	743,632
Methanol, refined, gal.	373,780	423,244
Byproduct coke, 1,000 tons	4,266	4,664
Alcohol ethyl, 1,000 gal.	13,245	15,216
Alcohol, ethyl, withdrawn for denaturing, 1,000 gal.	11,319	13,812
Automobiles, cars, no.	362,270	514,863
taxis, no.	514	1,310
trucks, no.	54,370	88,510
Explosives, 1,000 lb.	36,147	37,235
Glass, plate, 1,000 sq. ft.	12,571	12,782
Rosin, wood, bbl.	40,933	37,708
Turpentine, wood, bbl.	7,454	6,855
Pine oil, gal.	234,281	219,304
Cottonseed oil, crude, 1,000 lb.	47,137	40,193
Cottonseed oil, refined, 1,000 lb.	57,041	60,656

Consumption

	May 1930	May 1929
Cotton, bales	473,917	668,650
Silk, bales	40,823	49,121
Wool, 1,000 lb.	32,641	48,765
Cottonseed oil, bbl.	274,693	299,280

While production in some cases has outstripped consuming demand, the chemical industry as a whole is in a sound position with the possible exception of the wood-distillation branch. Shipments of acetate of lime for the first five months of the year were 30,271,482 lb., compared with 59,678,222 lb. for the five-month period of 1929. On the other hand, stocks at the end of May amounted to 28,392,156 lb., as against 1,866,514 lb. on May 31, 1929. Crude methanol production has been declining, but stocks on May 31 were 1,490,041 gal., compared with 496,742 gal. on May 31, 1929. The competition from synthetic methanol has been gaining in intensity, with no signs that it will lessen. Demand for acetate of lime from acid makers has been curtailed because of the larger quantities of synthetic acetic acid which have been seeking a market.

ONE of the most encouraging signs in the present market is found in the plans for expansion which are now in operation or which are soon to be put into effect. These plans demonstrate the confidence which chemical executives have in the future of the industry. Without attempting to fix the time when greatly increased consuming demand will be met, they are enlarging plant capacities so that this demand can be satisfied.

Another encouraging factor consists in the fact that consuming industries are not carrying large stocks of raw materials. Producers likewise have reduced surplus holdings and the Federal Reserve Board represents stocks of chemicals and oils at the close of May by the index number 75, compared with 100 for the preceding month and 96 for the close of May, 1929.

The status of chemical consumption in the rubber industry may be inferred from a report of the Rubber Manufacturers' Association which states that with the exception of 1929, consumption of crude rubber for the first six months of 1930 was the highest on record. The figure, 216,182 long tons, although 19.3 per cent below 1929, was 4.4 per cent above the same period in 1928, 6.8 per cent above 1927, 19.2 per cent above 1926, 7.7 per cent over 1925, 32.3 per cent over 1924, 16.0 per cent over 1923.

MANUFACTURING production in May, after adjustments for seasonal variations, registered a decline of 2 per cent from the month of April, and was considerably below the level of a year ago, according to the weighted index of the Federal Reserve Board. The production of leading minerals, although recording a gain of 1 per cent over the preceding month, was lower than during May, 1929. Industrial production, including both manufacturing and mineral output, registered declines from both comparative periods.

The general index of commodity stocks held at the end of May was lower than in the previous month and 4 per cent above the level of a year ago. The stocks of finished goods in the hands of manufacturers showed decreases from both the month of April, 1930, and May, 1929.

Unfilled orders for manufactured goods at the end of May, recorded declines from both the preceding period and May, last year. As compared with May, 1929, unfilled orders for transportation equipment showed a gain of 10 per cent, while other lines registered declines. As compared with May, 1928, increases occurred in unfilled orders for iron and steel, and transportation equipment.

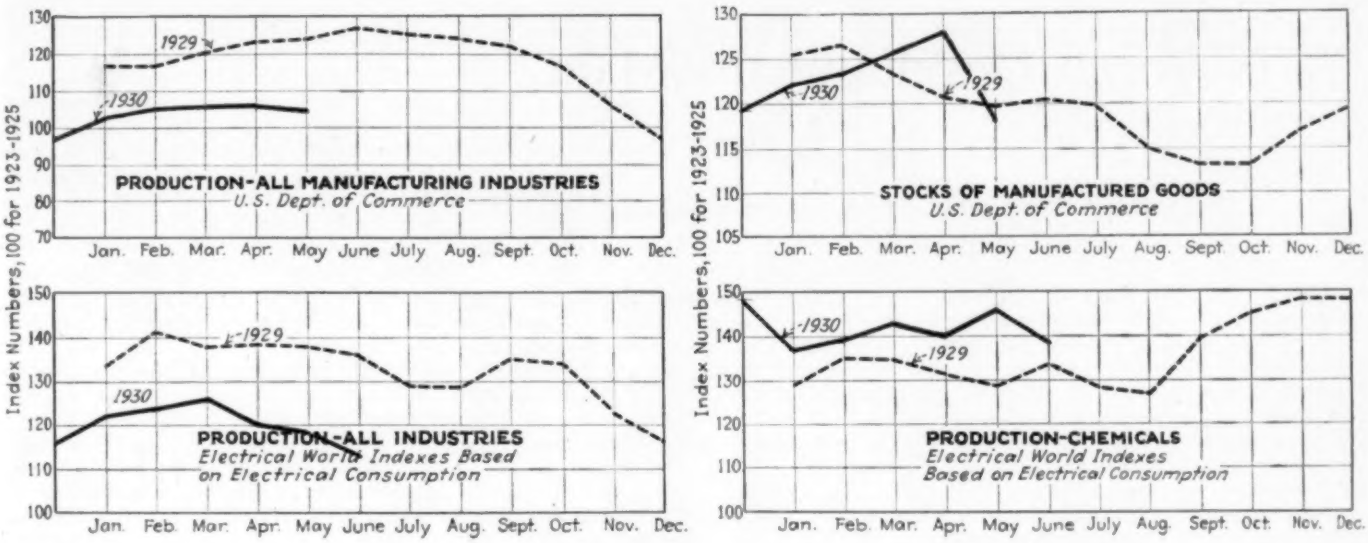
Normal Business By October

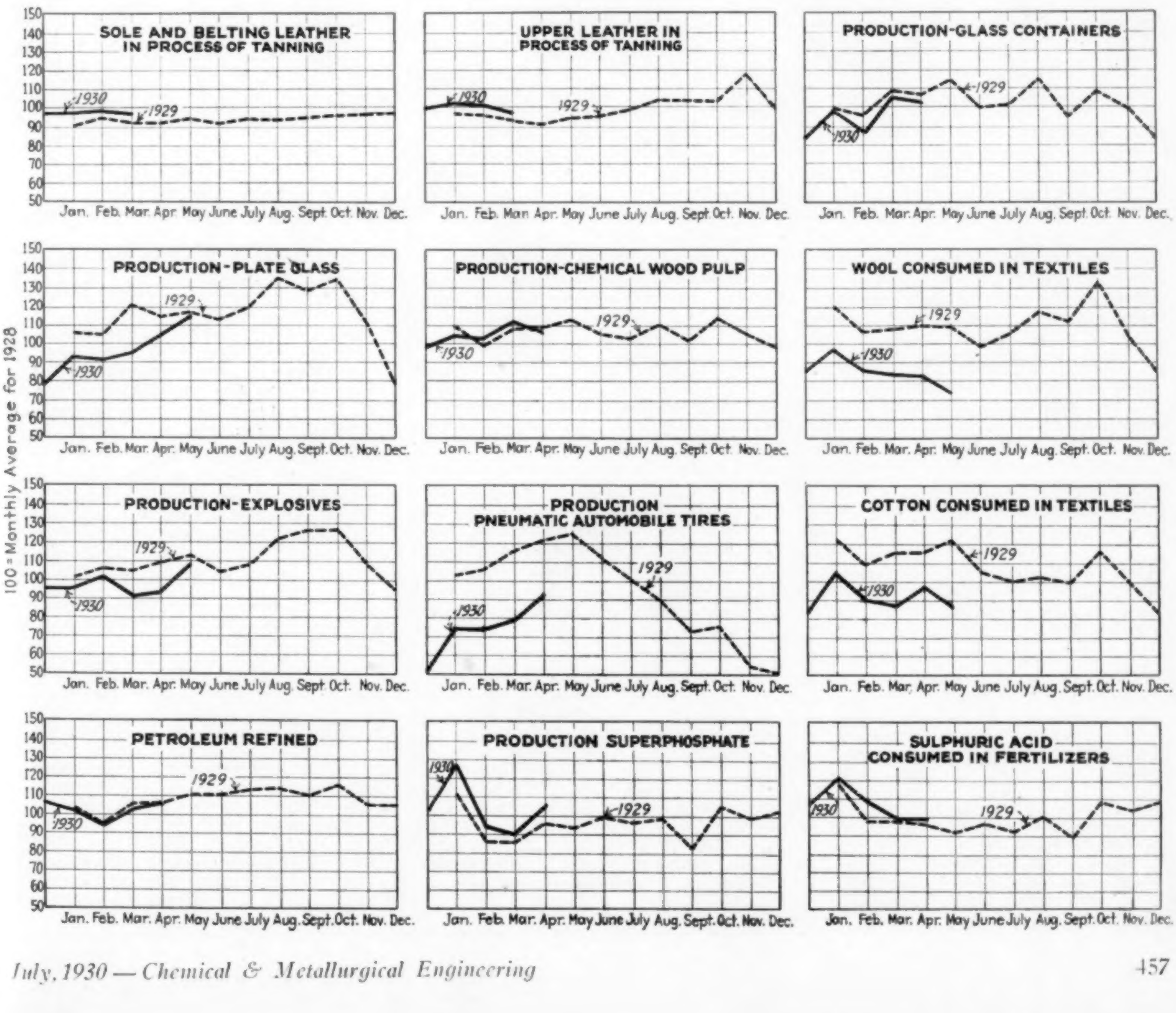
In its issue of July 2 *The Business Week* states "The business tide has reached its ebb during the past two weeks, and is beginning to turn, very slowly and tentatively, in face of a strong current of peevish superficial, and premature pessimism.

"There will be no noticeable change in the next few weeks. Continued liquidation in certain lines will overlap and obscure increasing resistance, stabilization, and upturn in others. Progress will be slow, irregular, spasmodic, with sporadic relapses, successively less frequent and sharp, till the end of July. Then, in the same few weeks when a year ago the downturn began, a decisive recovery will set in, general and definite enough to be evident even to the blue-funk brigades of business who have been enjoying their May-parties and June-walks in the cemetery.

"The rise of the business curve thereafter will be rapid, and will, as usual, steal a march on the slow-witted and self-centered stock market. By October it will be back to normal."

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES





MARKET CONDITIONS AND PRICE TRENDS

Nitrogen Developments Main Feature in Market

Contract Prices for Coming Season Awaited by Consuming Industries

THE consolidation of Chilean nitrate of soda producers, quota assignments of international nitrogen producers, and the awaiting of new contract prices for nitrate of soda and sulphate of ammonia have been the principal points of interest in the market during the past month.

Formation of the nitrate of soda combination, in which producers and the Chilean government figure as principals, was carried forward another step on July 10, when the Chilean Senate approved the bill which provides for the creation of the consolidated company to be known as Compania Salitreara Nacional. As the consolidation in Chile comes closer to realization the question is arising whether the project will be carried still further so as to embrace a working agreement with producers of synthetic nitrate. In any event, developments in Chile are calculated to place nitrate of soda in a more favorable position in competition in the markets of the world. Incidentally, Chile is observing the First Nitrate Centennial, nitrate of soda having been first produced there on a commercial scale in 1830.

While no definite information has come to hand regarding the outcome of the meeting of nitrogen producers which has been in session in Paris, it is regarded as probable that an agreement will be reached whereby producers of the synthetic product will work under production quotas and distribution allotments.

FROM a produced standpoint, the union of nitrogen producers and the contention for supremacy between different groups is of interest mainly because of the effect which will be shown in the sales prices of nitrogen-bearing materials. At present new contract prices are expected for nitrate of soda and sulphate of ammonia. Recent sales of sulphate of ammonia have been made at lower prices than were available a month ago, hence the expectation is that contract prices will be lower than they were last season.

Trading in chemicals in the last month has been of a spotty character, with seasonal dullness restricting demand for many selections. Copper sulphate and other agricultural chemicals have sold in large volume and fertilizer chemicals also have moved in a large way. Fertilizer tag sales in the Southern states have run above the totals reported for last year. Chlorine, after a reduction in price, found a better consuming demand.

ANNOUNCEMENT has been made that with certain exceptions, all regulations pertaining to the regulation of industrial alcohol and other legal uses of alcoholics in force June 30 will be continued in force until Sept. 1, after which they shall be void. In the meantime, new regulations will be prepared jointly by the Department of Justice and the Treasury Department.

The summer months usually form a dull period in the market for industrial alcohol, and this season is proving no exception to the rule. Competition has been keen for whatever business was passing and buyers have found no difficulty in shading the quoted prices.

Methanol also has been unstable in price, with sales going through at concessions.

Progress of the growing cotton and flaxseed crops has been followed closely by the vegetable-oil trade. The reduction in the cotton acreage from last season has been small and as weather conditions in general have been favorable, a large outturn is in prospect. This has exerted a bearish influence on values for cottonseed oil, and competing oils also have been affected.

The menhaden fishing season has been under way for some time, but prices for crude menhaden oil remain nominal with buyers adopting a waiting policy.

In the latter part of last year, representatives of companies producing about 92 per cent of the world output of carbon black formed an export association to promote the rapidly growing interests of American carbon-black manufacturers in foreign markets. It has recently been announced that the association had filed papers under the Webb-Pomerene law which grants exemption from the anti-trust laws to an association entered into and solely engaged in export trade. The importance of export trade in carbon black may be noted from the fact that total sales in 1929 amounted to 283,806,000 lb., of which 91,829,000 lb., or 32 per cent, was sold for export.

Large Flaxseed Crop In Prospect

Last week the Crop Reporting Board of the Department of Agriculture issued the first preliminary report on the flaxseed crop of this season. A material increase over last year is shown in the acreage figures. Condition and yield per acre also are better than was reported a year ago for the 1929 crop. The report is based on conditions as of July 1 and offers the following comparisons:

	July 1, 1929	July 1, 1930
Condition	71.5	78.4
Acres, 1,000	3.092	4,389
Yield per acre, bu.	6.4	6.9
Estimated production, 1,000 bu.	19,900	30,100

Final report for 1929 placed acreage at 2,992,000 and production at 16,838,000 bu.

Sales of Cold Water Paints And Calcimines

SALES of plastic paints, cold-water paints, and calcimines in May, as reported to the Department of Commerce by 27 manufacturers, including the leading producers, amounted to 5,168,-665 lb. valued at $303,836, as compared with 5,801,067 lb. valued at $347,844, in April. This summary inaugurates a new monthly compilation, and will be subject to revision in subsequent issues as additional reports are received. Detailed statistics for the first five months of the current year are given below:

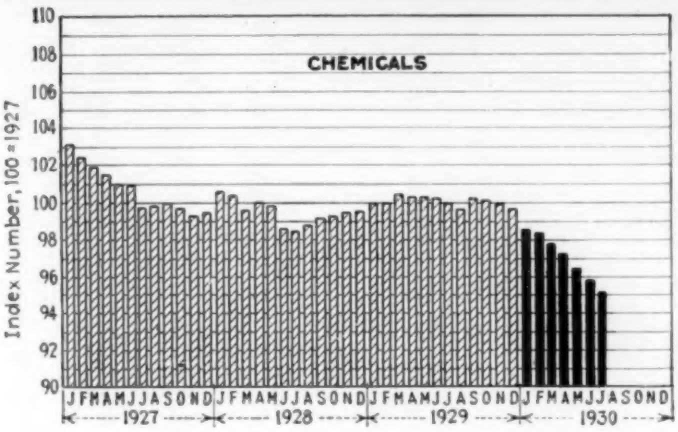
Plastic Paint

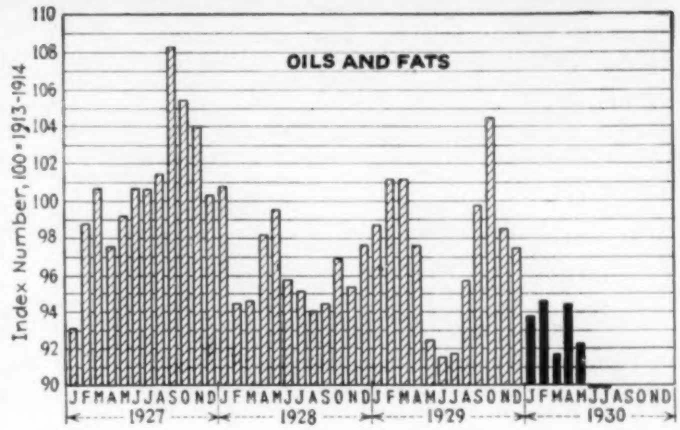
	In Paste Form		In Dry Powder Form	
1930	Lb.	Value	Lb.	Value
Jan.	*	$40,490	*	$55,496
Feb.	*	52,784	*	69,400
March	*	58,692	*	89,412
April	472,216	64,982	765,504	86,224
May	323,130	46,067	559,219	61,664
Total (5 mos.)	....	$263,015	....	$362,196

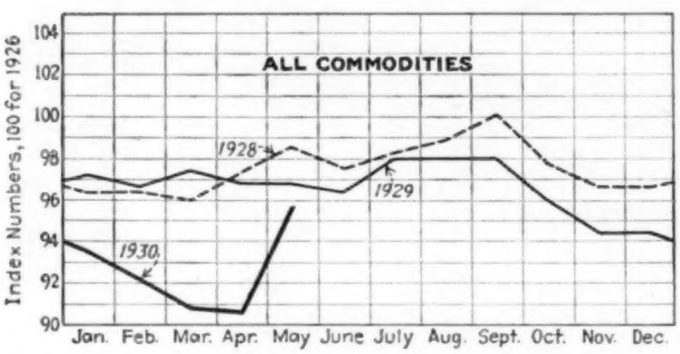
	Cold Water Paint		Calcimines	
1930	Lb.	Value	Lb.	Value
Jan.	*	$61,183	*	$107,281
Feb.	*	63,698	*	124,180
March	*	46,130	*	130,506
April	1,445,689	60,354	3,117,658	136,284
May	1,066,867	54,578	3,219,449	141,527
Total (5 mos.)	....	$285,943	....	$639,778

* Not yet available.

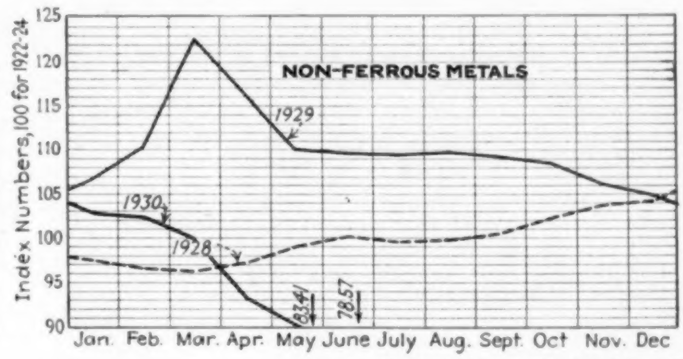
CHEM. & MET. *Weighted Indexes of* PRICES







U. S. Department of Labor



Engineering & Mining Journal

Lower Price Levels Reached in Chemical Market

CHANGES in sales schedules for chemicals during the last month were all in favor of buyers. Acetate of lime, acetic acid, tartaric acid, chlorine, tri-sodium-phosphate, sulphate of ammonia, tin salts, lead pigments, and naval stores may be mentioned among the commodities for which reduced sales prices became effective.

The decline in values for acetate of lime and acetic acid had been anticipated because of the marked falling off in demand for the former and the increased competition which producers of acetic acid were forced to meet as a result of larger offerings of the synthetic product. As production of synthetic acetic acid is increasing and stocks of acetate of lime are large a nearby recovery in values is not to be expected and the position of producers appears to become increasingly less favorable.

Sales of spot sulphate of ammonia at reduced prices was regarded as significant in view of the larger prospective domestic production, competition from foreign markets, and developments in the Chilean nitrate industry. While nitrogen-bearing materials are selling at comparatively low levels the position of the market would indicate that still further recessions in values was probable.

In considering price trends in general, attention must be given to the fact that hand-to-mouth buying has continued for several months. In other words, there is ample evidence that consumers in various lines are working on abnormally small supplies of raw materials. Hence improvement in general industrial conditions would necessarily be accompanied by a more active buying period which could easily have a strengthening effect upon prices.

Estimates on the acreage of the growing cotton crop foretell a yield not far from that realized last season. A large cottonseed supply combined with large reserves of cotton oil is not favorable for higher prices for oil. As many other vegetable oils are influenced by conditions in the market for cotton oil, the outlook for higher prices is not bright.

An outturn of flaxseed in excess of 30,000,000 bu. in the American northwest is indicated by growing conditions reported as of July 1. This total falls short of domestic requirements but is large enough to warrant belief that new crop options will not seek high price levels.

Shipments of China wood oil from Hankow to the United States for the first half of this year amounted to 74,456,000 lb. compared with 54,237,465 lb. for the corresponding period of 1929. This accounts for the easy tone noted in domestic markets.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**95.15**
Last month	95.87
July, 1929	100.03
July, 1928	98.49

Lower prices prevailed in sales of acetate of lime, acetic acid, methanol, sulphate of ammonia, chlorine, ethyl acetate, tri-sodium phosphate, and spirits of turpentine. In some cases where the open quotation was unchanged, buyers were able to obtain concessions.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**88.28**
Last month	89.23
July, 1929	91.84
July, 1928	95.11

Crude cottonseed was in a more or less nominal position. Linseed oil moved up for a time following higher markets for flaxseed, but closed at the same level as last month. Other vegetable oils and fats sold at lower price levels.

MARKET APPRAISAL OF CHEMICAL INDUSTRY

ACQUISITION of the Rossville Commercial Alcohol Company and the General Industrial Alcohol Company by American Solvents & Chemical Corporation has been consummated. H. I. Peffer resigned as president of the last-named company and was elected chairman of the board and chairman of the executive committee. Victor M. O'Shaughnessy, of Rossville Commercial Alcohol, becomes president of the new company.

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Archer-Daniels-Midland Company reports for the nine months ended on May 31 a net profit of $1,159,752 after depreciation and federal taxes, equivalent to earnings of $1.74 a share on the common stock after allowing for the preferred dividend requirements. In the nine months ended on May 31, 1929, net profit was $950,382, equal to $1.54 a share on the common stock then outstanding.

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Earnings of the Freeport Texas Company for the six months ended on May 31 were $1,832,160 after depreciation, federal taxes and other charges, equivalent to $2.51 a share, compared with $2.56 a share in the corresponding period of the preceding fiscal year.

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Stockholders of James S. Kirk & Company have ratified sale of the company to Procter & Gamble. A quarterly dividend of 60 cents has been declared on common stock of Procter & Gamble. Previous rate was on basis of $2 a year.

•

The Wesson Oil & Snowdrift Company and subsidiaries reported for nine months ended May 31, net profits of $2,237,531, after depreciation and federal taxes, being equal to $1.73 a share on outstanding common stock, after preferred dividend requirements. Consolidated balance sheet of the company showed total assets of $42,935,497.

•

The Liquid Carbonic Corporation has reported net earnings of $823,521 for the eight months ended May 31, after deducting expenses and taxes. This net is equal to $2.40 a share on the outstanding stock and compares with $671,562, or $1.95 a share, earned for the same period in 1929.

•

Devoe & Raynolds, Inc., and subsidiaries, report for six months ended May 31, 1930, profit of $152,148 after expenses and charges, but before federal taxes, comparing with $519,216 in first half of previous fiscal year. The dividend on common stock for the third quarter has been reduced from 60 cents to 30 cents a share.

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The Eagle-Picher Lead Company has omitted the quarterly dividend of 20 cents on the common stock. The regular quarterly dividend of $1.50 on the preferred was declared. The shrinkage in inventory values occasioned by the decline in metal prices during the past few months was given as the reason for the omission of the common dividend.

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Reports from the Pacific Coast state that Consolidated Chemical Industries may improve on its record earnings of last year. The company is said to have experienced a record month last May with sales at a rate in excess of $4,000,000 for the year.

Price Range 1930 High	Price Range 1930 Low	Stock	Price Range in June: June 2	High	Low	June 30
34	19	Agfa Ansco Corp	....	23¾	23¾	....
156½	114	Air Reduction	156	156½	114	126½
2½	1	Ajax Rubber	1¼	1½	1	1½
343	232	Allied Chemical	314	318	232	271
356	210	Aluminum Co	....	303	210	....
10⅞	4½	Am. Ag. Chemical	7	7½	4½	5½
33	9¾	Am. Commercial Alcohol	17½	17½	9¾	9¾
37	17½	American Cyanamid, B	26¼	26½	17½	19⅞
7	3½	American Hide & Leather	....	5	3½	....
51½	30½	American Metals	40½	40½	30½	34
22½	6¼	Am. Solvents & Chemical	11½	12	6¼	7½
43⅞	15¾	Anglo-Chile Nitrate	40½	40½	25	....
29¾	18⅞	Archer-Daniels-Midland	24½	24½	18⅞	....
8⅞	4¾	Armour, Ill., A	6½	6¼	4¾	5½
51½	30⅞	Atlantic Refining	43½	44	30⅞	35⅞
106	62	Atlas Powder	....	80⅞	62	....
70¾	49⅞	Beechnut Packing	....	57	49⅞	50¾
29⅞	28	California Petroleum	....	28	28	....
35	17	Celanese	....	23¾	17	....
20	13½	Celluloid Corp	....	15	15	....
15⅞	5⅛	Certainteed	9½	9⅞	5⅛	5⅛
32¾	20	Chickasha Cotton Oil	21½	21½	20	....
64⅞	50	Colgate-Palmolive-Peet	62⅝	62½	50	51½
199	108	Columbian Carbon	161	162¾	108	124
38	20¼	Commercial Solvents	30¼	30½	20¼	23¼
111⅞	87⅞	Corn Products	107¾	108¼	87⅞	94
43½	24⅞	Davison Chemical	35¾	35⅞	24⅞	27½
42¾	22	Devoe & Raynolds	....	38½	22	22
100	71	Dow Chemical	....	96	71	71
145¼	100⅞	DuPont	130¼	131½	100⅞	104½
121	114½	DuPont, 6 pc. deb	120⅞	120¼	117½	....
21	5⅞	Duval Texas Sulphur	....	13	5⅞	....
255½	175¾	Eastman Kodak	242½	247	178	201¼
33½	20	Firestone Tire	23¾	24	20	....
5½	2⅞	Fisk Rubber	3¾	3⅞	2⅞	2½
55½	33	Freeport Texas	47⅞	51⅞	33	40½
71½	38⅞	General Asphalt	59¾	60½	38⅞	43
38	15½	Glidden Co	25	25	15½	16
47⅞	34½	Gold Dust	45½	45½	34½	37¾
58½	22½	Goodrich Co	41⅞	41⅞	22½	27
85	60	Hercules Powder	....	72¼	60	....
23	15	Heyden Chemical	....	18	15	....
116⅞	52¼	Houston Oil	103⅞	110⅞	64½	77
....	....	Imperial Chemical Ind.	....	....	....	....
124	73	Industrial Rayon	102	102	73	80¼
8½	4½	Int. Ag. Chemical	6½	8	4⅞	7
44⅞	21	International Nickel	32¼	33⅞	21	25¼
18	9	International Paper, C	14	14	9	....
25	18⅞	Kellogg, Spencer & Sons	21½	21½	18⅞	....
6½	3	Kelly-Springfield	4¼	4⅞	3	3⅞
11	4½	Lee Rubber & Tire	7½	7½	4½	....
36	22¼	Lehn & Fink	27¼	28¼	22¼	24⅛
31½	19½	Libby-Owens	23	23¼	19½	20
81⅞	52¼	Liquid Carbonic	73⅞	80¼	61	68¼
37⅞	18½	McKesson & Robbins	27⅛	27½	18½	22
51⅞	32⅞	Mathieson Alkali	46	46¼	32⅞	36½
63¼	35	Monsanto Chemical	56¾	56¼	35	37⅛
39½	24½	Nat'l Distillers Products	35	35½	24½	28¼
189⅞	125	National Lead	....	149	125	....
91½	65¼	New Jersey Zinc	....	76¼	65¼	66½
76½	62½	Ohio Oil	75	76⅞	62½	65
60⅛	45¼	Owens-Ill. Glass	52	52¾	45¼	48
44¾	29½	Phillips Petroleum	38	38⅞	29¾	31½
59¼	45½	Pittsburgh Plate Glass	....	50⅛	46¼	....
57⅞	50⅞	Pratt & Lambert	....	....	....	....
78⅞	52⅛	Procter & Gamble	78	78⅞	67	71
27¼	19½	Pure Oil	23	23	19½	20¼
85	80	Sherwin-Williams	....	....	....	....
34½	15½	Silica Gel	25	25	15½	....
32	20	Sinclair Oil	27½	29½	20	21¾
42	28½	Skelly Oil	36⅞	36⅞	28½	29⅞
75	55½	Standard Oil, Cal	70¼	71¼	57½	59¾
84½	58	Standard Oil, N. J.	79¾	80¼	61	65½
40⅞	30	Standard Oil, N. Y.	36¾	37½	30	31½
3	¾	Standard Plate Glass	1¼	1¼	¾	....
70	50	Sun Oil	....	67⅞	56⅞	....
10	7	Swan & Finch	....	7	7	....
34½	28	Swift & Co	31⅞	31⅞	28	28⅛
17	10⅞	Tennessee Copper & Chemical	....	14½	10⅞	11¾
60½	50⅞	Texas Corporation	58⅞	58½	50⅞	51⅛
67⅞	48⅞	Texas Gulf Sulphur	59½	60⅛	48⅞	52½
17¾	10¼	Tidewater Assoc. Oil	17⅞	18	12	15
106⅞	60⅞	Union Carbide	86½	85¾	60⅞	69¾
50	37	Union Oil, Cal	45¾	45¾	37	39¾
84	40⅞	United Carbon	67¾	68½	40⅞	45½
32⅞	22	United Piece Dye	....	27	22	....
139⅞	62	U. S. Industrial Alcohol	88½	90⅞	62	65½
15¼	7½	U. S. Leather	12⅞	12⅞	9½	....
35	20	U. S. Rubber	31⅞	32¼	20	22⅞
97⅞	76½	Vacuum Oil	94½	94¾	76¼	82¾
143¾	49⅞	Vanadium Corp	122¼	124	69⅞	80¾
47¼	37½	Vick Chemical	47½	47⅞	39⅞	....
8⅛	4	Va-Ca Chemical	6¼	6¼	4	4½
29⅞	22½	Wesson Oil	28¼	28¼	23	24
59⅞	30	Westvaco Chlorine	45	45	30	....
7⅞	3⅛	Wilson & Co	....	4¾	3½	4½

Sales of Lead and Zinc Pigments Reported for 1929

Deliveries of Lithopone Were Highest on Record

SALES OF the colored lead pigments—red lead, orange mineral, and litharge—increased in 1929, but sales of white lead and basic lead sulphate (white) decreased, according to the United States Bureau of Mines. The average values per ton reported for all of the lead pigments sold in the United States in 1929, with the exception of orange mineral, showed increases over the previous year.

Sales of the different zinc pigments and salts were relatively stationary or higher, with lithopone reaching a new high record for all times. The average values of zinc oxide and leaded zinc oxide dropped somewhat and that of lithopone increased a little.

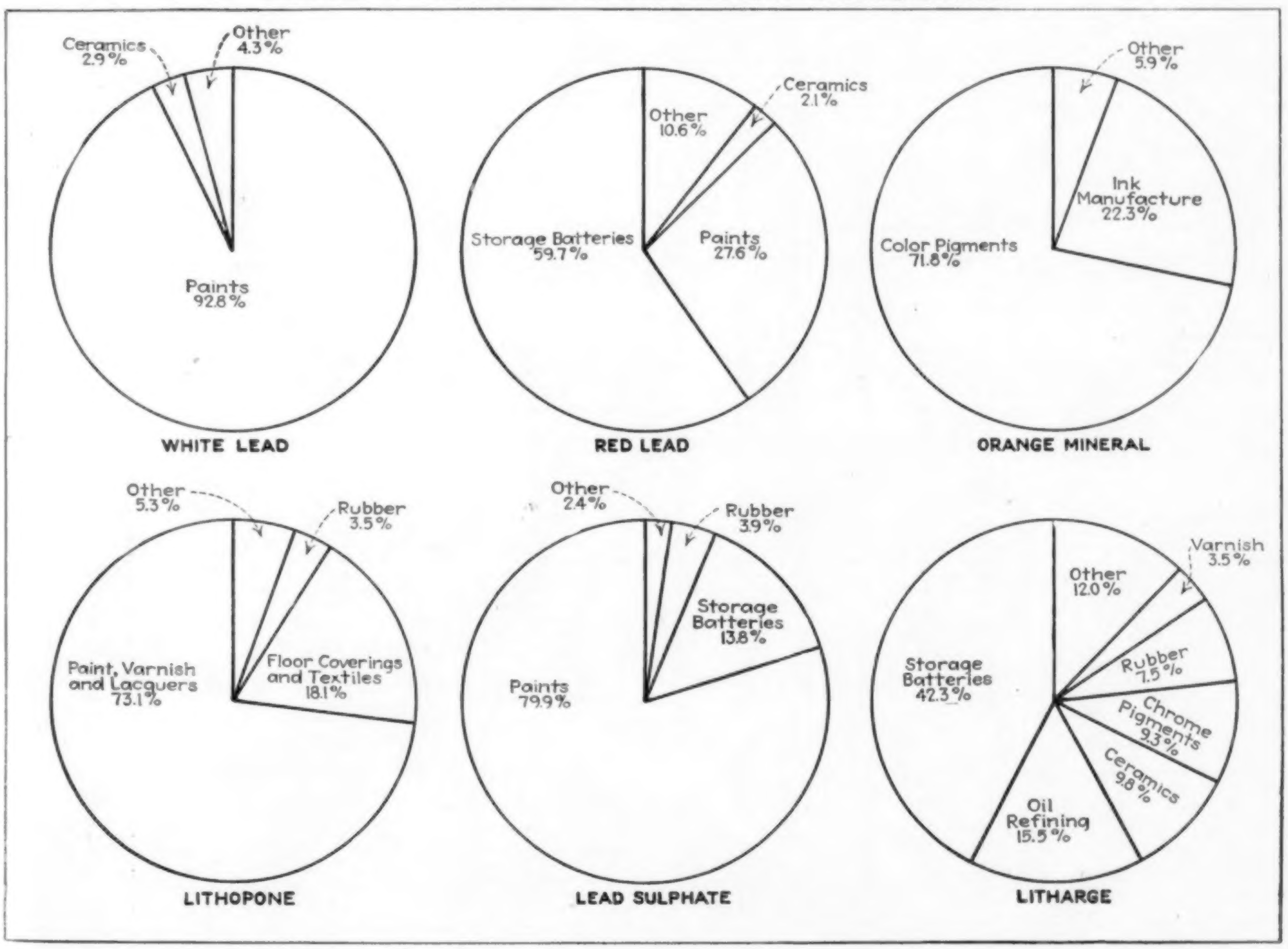
The Bureau of Mines has obtained data from the lead and zinc pigment producers covering the sales of white lead, basic lead sulphate, red lead, orange mineral, litharge, and lithopone, in 1929, by uses. Information regarding sales of zinc oxide and leaded zinc oxide by uses is incomplete and it is impossible, therefore, to show the distribution of these pigments. Lithopone producers report an annual productive capacity of 241,000 tons.

	Short tons
White Lead	
Paints	136,526
Ceramics	4,246
Other	6,259
	147,031
Red Lead	
Storage batteries	25,689
Paints	11,855
Ceramics	903
Other	4,574
	43,021
Orange Mineral	
Color pigments	487
Ink manufacture	151
Other	40
	678
Lithopone	
Paint, varnish and lacquers	150,804
Floor coverings and textiles	37,506
Rubber	7,176
Other	10,829
	206,315
Basic Lead Sulphate	
Paints	13,435
Storage batteries	2,327
Rubber	655
Other	397
	16,814
Litharge	
Storage batteries	37,160
Oil refining	13,615
Ceramics	8,663
Chrome pigments	8,112
Rubber	6,651
Varnish	3,124
Linoleum	322
Other	10,269
	87,916

Lead and Zinc Pigments and Zinc Salts Sold by Domestic Manufacturers in the United States, 1928-29

	1928			1929		
		Value			Value	
	Short tons	Total	Per ton	Short tons	Total	Per ton
Basic lead sulphate or sublimed lead:						
White	16,002	$2,211,470	$138	15,580	$2,274,917	$146
Blue	1,234	175,508	142	1,234	195,849	159
Red lead	40,497	6,816,876	168	43,021	7,586,543	176
Orange mineral	459	112,521	245	678	165,039	243
Litharge	85,570	12,872,730	150	87,916	13,807,087	157
White lead:						
Dry	42,049	6,688,115	159	42,159	6,821,220	162
In oil	111,923	24,553,989	219	104,872	23,679,875	226
Zinc oxide	160,904	20,685,442	129	160,611	20,516,246	128
Leaded zinc oxide	24,223	2,945,323	122	27,149	3,224,544	119
Lithopone	200,468	19,073,914	95	206,315	19,773,864	96
Zinc chloride, 50° Baumé	38,837	1,706,222	44	39,615	1,351,925	34
Zinc sulphate	2,293	132,235	58	5,057	207,297	41

Distribution of Lead and Zinc Pigments According to Consuming Industries



CURRENT PRICES in the NEW YORK MARKET

THE following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to July 14.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.11 -\$0.12	\$0.11 -\$0.12	\$0.14 -\$0.15
Acid, acetic, 28%, bbl., cwt	3.11 - 3.26	3.88 - 4.03	3.88 - 4.03
Boric, bbl, lb.	.06¾- .07	.06¾- .07	.06¼- .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10 - .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10½	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.00- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.34½- .36	.36 - .38	.38 - .39
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63 -......	2.63 - 2.71	2.68½- 2.71
Alcohol, Butyl, tanks, lb	.16¾- .17	.16¾- .17	.16½- .17
Alcohol, Amyl	......-......	......-......	......-......
From Pentane, tanks, lb	.236-......	.236-......	......-......
Denatured, 190 proof			
No. 1 special dr., gal	.42 -......	.42 -......	.50 -......
No. 5, 188 proof, dr., gal.	.42 -......	.42 -......	.50 -......
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.05 - .05½	.05½- .05¾	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03 - .03½	.02¾- .03½
Aluminum sulphate, com., bags, cwt	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	2.00 - 2.10
Aqua ammonia, 26°, drums., lb	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl., lb.	.15 -......	.15 -......	.14 -......
Ammonium carbonate, powd. tech., casks, lb	.10½- .11	.10½- .11	.12 - .13
Sulphate, wks., cwt	1.85 -......	2.00 -......	2.20 -......
Amylacetate tech., tanks, lb., gal.	.147-......	2.22 -......	......-......
Antimony Oxide, bbl., lb	.08½- .10	.09 - .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 -60.00	58.00 -60.00	57.50 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	64.00 -70.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033- .033	.033- .033	.02½- .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags	3.00 -......	4.50 -......	4.50 -......
Arsenate, dr., lb	.07 - .08	.07 - .10	.06½- .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -......	20.00 -......	20.00 -......
flake, dr., wks., ton.	22.75 -......	22.75 -......	22.75 -......
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb	.05½- .06	.05½- .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb	.024-......	.02½-......	.03 -......
Cylinders	.04 - .06	.04½- .06	.05 - .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton	13.00 -14.00	13.00 -14.00	16.00 -17.00
Copper carbonate, bbl., lb	.10 - .18	.10 - .18	.19 - .21
Cyanide, tech., bbl., lb.	.45 - .46	.49 - .50	.49 - .50
Sulphate, bbl., cwt	4.75 - 5.00	4.75 - 5.00	6.00 - 6.10
Cream of tartar, bbl., lb	.26¼- .27	.26¼- .27	.27½- .28
Diethylene glycol, dr., lb	.11 - .13	.11 - .13	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.106-......	.121-......	.125-......
Formaldehyde, 40%, bbl., lb.	.07½- .08	.07½- .08	.09½- .10
Furfural, dr., contract, lb	.10 - .12	.10 - .12	.15 - .17
Fusel oil, crude, drums, gal	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Galubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.13 - .13½	.14 - .14½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.07¾-......	.07¾-......	.09 -......
White, basic sulphate, sck., lb.	.07½-......	.07½-......	.08½-......
Red, dry, sck., lb	.08¾-......	.09 -......	.10½-......
Lead acetate, white crys., bbl., lb.	.13 - .14	.13 - .14	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.13 - .14	.12 - .13
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb	.07¾-......	.08 -......	.09½-......
Lithopone, bags, lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½- .07
Methanol, 95%, tanks, gal	.38 -......	.38 -......	.55 -......
97%, tanks, gal.	.39 -......	.39 -......	.55 -......
Synthetic, tanks, gal	.40½- .45	.40½-......	....

	Current Price	Last Month	Last Year
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Single, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.11 -......	.11 -......	.12½-......
Phosphorus, red, cases, lb	.42 - .44	.42 - .44	.55 - .57
Yellow, cases, lb.	.31 - .32	.31 - .32	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08½- .09	.08½- .09	.07½- .08½
Cyanide, cs., lb	.52 - .55	.52 - .55	.51 - .53
F'rst sorts, csk., lb.	.08¾- .09	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr., lb	.06½- .06¾	.06¾- .06¾	.07½- .07½
Muriate, 80% bgs., ton	37.15 -......	37.15 -......	36.75 -......
Nitrate, bbl., lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.19 - .19½
Sal ammoniac, white, casks, lb	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	20.00 -22.00	20.00 -22.00	16.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 -......	1.32 -......	1.32 -......
Dense, bags, cwt.	1.35 -......	1.35 -......	1.35 -......
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	2.90 - 3.00
Acetate, works, bbl., lb.	.04 - .05	.04 - .05	.05 - .05½
Bicarbonate, bbl., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton.	14.00 -16.00	14.00 -16.00	12.00 -15.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03¾- .04
Chlorate, kegs, lb	.07½- .08	.07½- .08	.06¾- .06½
Chloride, tech., ton	12.00 -14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½- .09	.08½- .09½	.08¾- .09
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	2.07 -......	2.10 -......	2.15 -......
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.03 - .03½	.03 - .03½	.03½- .03¾
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.03½- .04
Sulphite, crys., bbl., lb	.03 - .03½	.03 - .03½	.02½- .03
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb.	.05 - .06	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.06½- .07	.07 - .08	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -......	nom. -......	.14½-......
Oxide, bbl., lb.	.36 -......	.40 -......	.53 -......
Crystals, bbl., lb	.27½-......	.27½-......	.35½-......
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.07½- .08	.08 - .08½	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½-......	.06¾-......	.06½-......
5% lead sulphate, bags, lb.	.06½-......	.06¾-......	.06½-......
Sulphate, bbl., cwt.	3.00 - 3.25	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.11¾-\$0.12½	\$0.12 -\$0.13	\$0.13½-\$0.14
Chinawood oil, bbl., lb.	.09 -......	.19¾-......	.14½-......
Coconut oil, Ceylon, tanks, N.Y., lb.	.06½-......	.06¾-......	.06¾-......
Corn oil crude, tanks, (f.o.b. mill), lb.	.06½-......	.07½-......	.07¾-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07½-......	.07 -......	.07¾-......
Linseed oil, raw, car lots, bbl., lb.	.138-......	.14 -......	.113-......
Palm, Lagos, casks, lb	.06 -......	.07½-......	.07½-......
Niger, casks, lb.	.05½-......	.06½-......	.07½-......
Palm Kernel, bbl., lb.	.07 -......	.07½-......	.08¾-......
Peanut oil, crude, tanks (mill), lb	.07½-......	.07¾-......	.08¾-......
Rapeseed oil, refined, bbl., gal.	.58 - .60	.70 - .72	.82 - .84
Soya bean, tank (f.o.b. Coast), lb.	.08½-......	.09½-......	.09½-......
Sulphur (olive foots), bbl., lb.	.07½-......	.07½-......	.10½-......
Cod, Newfoundland, bbl., gal	.55 - .57	.55 - .57	.65 - .67
Menhaden, light pressed, bbl., gal.	.54 - .55	.63 - .65	.70 - .72
Crude, tanks (f.o.b. factory), gal.	nom. -......	nom. -......	.43 -......
Whale, crude, tanks, gal	.78 -......	.78 -......	...... - .80
Grease, yellow, loose, lb.	.04¾-......	.04¾-......	.06¾-......
Oleo stearine, lb.	.08½-......	.08½-......	.09¾-......
Red oil, distilled, d.p. bbl., lb	.09 -......	.10 -......	.09½- .09½
Tallow, extra, loose, lb	.05½-......	.05½-......	.08½-......

Coal Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	\$0.60 -\$0.65	\$0.60 -\$0.65	\$0.60 -\$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.15 - .15½	.15 - .15½	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.21 - .23	.22 - .24	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.60 - .70	.60 - .70	.73 - .75
Diethylaniline, dr., lb	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.16 - .17	.16 - .17	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb	.68 - .70	.68 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.04½ - .05	.04½ - .05	.05 - .06
Nitrobenzene, dr., lb.	.08½ - .09	.08½ - .09	.08½ - .10
Para-nitraniline, bbl., lb	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb	.14¾ - .15	.14¾ - .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb	1.50 - 1.80	1.75 - 1.90	1.35 - 1.50
R-salt, bbl., lb	.44 - .45	.44 - .45	.47 - .49
Resorcinal, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .35	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.28 - .30	.28 -	.35 - ......
Tolidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.35 -	.35 -	.35 - ....
Xylene, com., tanks, gal.	.25 - .28	.28 - .30	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb	.13½ - .16	.13½ - .15	.16 - .17
China clay, dom., f.o.b. mine, ton	8.00 - 20.00	8.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.05 - .22	.05 - .22	.06½ - .07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	.31 - .32
Ultramine blue, bbl., lb.	.06 - .32	.06 - .32	.03 - .35
Chrome green, bbl., lb.	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb.	6.00 - 6.50	6.00 - 6.50	5.25 - 5.50
Para toner, lb	.77 - .80	.77 - .80	.70 - .80
Vermilion, English, bbl., lb	1.90 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl., lb.	.17 - .17¼	.17 - .17¼	.15½ - .16
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	5.75 - 7.00
Graphite, Ceylon, lump, bbl., lb.	.04 - .05	.04 - .05	.08 - .09
Gum copal Congo, bags, lb.	.07 - .09	.07 - .08	.07½ - .08
Manila, bags, lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases, lb.	.16 - .16½	.16 - .19	.22 - .23
Kauri No. 1 cases, lb	.48 - .50	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.), lb.	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc, ton	40.00 -	40.00 -	40.00 - ......
Pumice stone, lump, bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.	5.85 -	6.90 -	8.65 - ......
Turpentine, gal.	.43 -	.47 -	.53 - ......
Shellac, orange, fine, bags, lb	.50 - .52	.50 - .52	.61 - .62
Bleached, bonedry, bags, lb	.36 - .37	.36 - .37	.56 - .60
T. N. bags, lb.	.27 - .28	.27 - .28	.46 - .47
Soapstone (f.o.b. Vt.), bags, ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.), ton	9.50 -	9.50 -	10.50 - ......
300 mesh (f.o.b. Ga.), ton	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -	13.75 -	13.75 - ......

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.22 - $0.24	$0.23 - $0.25	$0.28 - $0.30
Beeswax, ref., light, lb	.35 - .36	.34 - .37	.41 - .42
Candelilla, bags, lb.	.18 - .20	.19 - .20	.23 - .24
Carnauba, No. 1, bags, lb.	.28 - .29	.31 - .32	.50 - .51
Paraffine, crude			
105-110 m.p., lb.	.04 - .04½	.04½ - .05	.04½ - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-	$200.00-	$200.00- ......
Ferromanganese, 78-82%, ton	94.00-99.00	94.00-99.00	105.00 ......
Spiegeleisen, 19-21%, ton	34.00-	33.00-	32.00 ......
Ferrosilicon, 14-17%, ton	39.00-	45.00	45.00- ......
Ferrotungsten, 70-80%, lb.	1.20	1.45-	1.35- ......
Ferro-uranium, 35-50%, lb.	4.50-	4.50-	4.50- ......
Ferrovanadium, 30-40%, lb.	3.15- 3.50	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.11½-	$0.12¾ -	$0.17¾- ......
Aluminum, 96-99%, lb.	.233	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.06¾	.07½-	.09¾- ......
Nickel, 99%, lb.	.35 -	.35 -	.35 - ......
Monel metal, blocks, lb.	.28 -	.28 -	.28 - ......
Tin, 5-ton lots, Straits, lb.	.29½-	.31¾	.45¾
Lead, New York, spot, lb.	.052-	.0545	.07 -
Zinc, New York, spot, lb.	.0447	.05 -	.07 -
Silver, commercial, oz.	.34¾-	.42½	.52¾
Cadmium, lb.	.70 - .75	.70 - .75	.85 - .95
Bismuth, ton lots, lb.	1.00 -	1.28 -	1.70 -
Cobalt, lb.	2.50 -	2.10 - 2.50	2.50 - ......
Magnesium, ingots, 99%, lb.	.85 - 1.10	.85 - 1.10	.85 - 1.10
Platinum, ref., oz.	43.00- 45.00	46.00- 48.00	70.00- 70.00
Palladium ref., oz.	26.00- 28.00	30.00- 35.00	42.00- 46.00
Mercury, flask, 75 lb.	117.00-	112.00-	123.00- ......
Tungsten powder, lb.	1.70- 1.75	1.35- 1.50	1.10- 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7.50- $8.00	$7.50- $8.50	$5.50- $8.75
Chrome ore, c.f. post, ton	21.50- 25.00	21.50- 25.00	22.00- 23.00
Coke, fdry., f.o.b. ovens, ton	2.75- 2.85	2.75- 3.85	2.85- 3.00
Fluorspar, gravel, f.o.b. Ill., ton	18.00- 20.00	18.00- 20.00	17.00- 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.31 - .36	.31 - .36	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.48 - .50	.48 - .50	.48 - .50
Monazite, 6% of ThO_2, ton	60.00-	60.00-	130.00-
Pyrites, Span. fines, c.i.f., unit	.13 -	.13 -	.13 - ......
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	15.25- 16.50	15.25 - 16.50	11.25 - 11.50
Zircon, 99%, lb.	.03 -	.03 -	.03 - ......

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

BAKELITE FACTORY—Francisco & Jacobus, Archts., 511 5th Ave., New York, will soon let contract for main building 1, 2, and 3 story, 405 x 410 ft.; manufacturing building 1 and 2 story, 100 x 200 ft.; Building 2, 1 and 2 story, 130 x 220 ft.; machine shop and garage 1 story, 100 x 100 ft.; power house, 1 story, 50 x 100 ft., also storage building, etc. at River Rd. and Reading R.R., in Bound Brook, N. J., for Bakelite Corp., 247 Park Ave., New York. Estimated cost $150,000 or more.

CELLAPHANE PLANT—Du Pont Cellaphane Co., 2 Park Ave., New York, plans the construction of a cellaphane plant at Amphill, Va. Estimated cost $2,000,000. Du Pont Engineering Co., Du Pont Bldg., Wilmington, Del., are engineers and contractors.

BREWERY and DISTILLERY — Bimini Enterprise, Inc., T. S. Dillingham, Pres., Miami, Fla., plans a brewery and distillery in Bimini, Bahama Islands. Estimated costs $56,000 and $12,000 respectively. G. Bruce, 502 Professional Bldg., Miami, Fla., is architect.

CANDY FACTORY — Margaret Burnham Candy Co., 3800 Piedmont Ave., Oakland, Calif., plans a 2 story factory, 46th Ave. and Telegraph Rd. G. Koster, 2355 Leavenworth St., San Francisco, is architect.

CANDY FACTORY—J. A. Thatcher, Archt., 37 Cowan Ave., Toronto, Ont., will soon award contract for a 5 story and basement, 53x 112 ft. factory, for Jenny Lind Candy Co., Ltd., c/o E. G. Robinson, 1010 Star Bldg., Toronto. Estimated cost $85,000.

ICE PLANT—Carbon Dioice & Chemical Co. Seattle, Wash., W. M. Foulton, Pres., Conrad, Mont., awarded contract for the construction of a plant at Farnham, Utah to Frick Machine Co., Waynesboro, Pa. Carbon dioxide gas from the Farnham well will be used for making dry ice. Estimated cost $150,000.

REFINERY (Lard, etc.)—Swift & Co., Packer and Exchange Aves., Chicago, Ill., or c/o G. Goetz, P.O. Box 879, Laredo, Tex., awarded contract for a 1 story, 65 x 94 ft. refinery for lard and by-products to include can making, building boiler room, etc. in Nueva Laredo, Mexico, to E. H. Page, 205 Ugarte Bldg., Laredo, Tex. Approximately $50,000.

VINEGAR PLANT—W. A. Kober, c/o Hotel Washington, Winchester, Va., will soon award contract for construction of vinegar plant, including tank and press buildings, etc., for H. J. Heinz Co., 1062 Progress St., Pittsburgh, Pa. Estimated cost $75,000 to $85,000. R. M. Trimble, Commonwealth Bldg. Annex, Pittsburgh, Pa., is architect.

CHEMICAL PLANT—Calco Chemical Co., 286 Spring St., New York, N. Y., will soon receive bids for the construction of a chemical plant and office at Bound Brook, N. J. Estimated cost to exceed $150,000. Joannes & Marlow, 420 Lexington Ave., New York, N. Y., are architects and Lange & Neska, 420 Lexington Ave., New York, are structural engineers.

CHEMICAL PLANT ADDITION—Harshaw Chemical Co., D. T. Perry, Secy., 1945 East 97th St., Cleveland, O., awarded contract for a 1 story, 80 x 80 ft. foundry at 1000 Newburgh Ave. to Mark Swisher, 5927 Euclid Ave., Cleveland. Estimated cost $40,000.

CHEMICAL PLANT—Merrimac Chemical Co., Chemical Lane, Everett, Mass., will soon award

contract for the construction of a 1 story shop in connection with plant. Estimated cost $40,-000. Private plans.

CHEMICAL PLANT ADDITION — Richards Chemical Works, 190 Warren St., Jersey City, N. J., awarded contract for a 1 story, 100 x 100 ft. addition to chemical plant to James Billington, 198 Fairmount Ave., Jersey City. Estimated cost $40,000.

CHEMICAL PLANT—Sharpe & Dohme, 1025 Arch St., Philadelphia, Pa., manufacturers of chemicals, awarded contract for the construction of a manufacturing plant at Broad and Wallace Sts. to United Engineers & Constructors, 112 North Broad St., Philadelphia. Estimated cost $40,000.

CHEMICAL PLANT—Shell Chemical Co., (subsidiary of Shell Oil Co.) Shell Bldg., San Francisco, Calif., awarded contract for first units of a fireproof chemical plant on 613-acre site at Pittsburg, Calif., to G. Wagner, Inc., 181 South Park, San Francisco. Estimated cost $5,000,000.

CHEMICAL PLANT—Wallace & Tierman Products Co., Inc., 11 Mill St., Belleville, N. J., will soon award contract for a 4 story, 78 x 170 ft. addition to factory for the manufacture of chlorine apparatus at Schuyler Ave. and Terrace Pl. Estimated cost $150,000. Fletcher-Thompson Inc., 542 Fairfield Ave., Bridgeport, Conn., are architects.

CHEMICAL and INSECTARY BUILDING—Regents of the University of California, 405 Hilgard Ave., Los Angeles, Calif., will receive bids until July 22, for the construction of chemical and insectary building at Riverside, Calif. Estimated cost $150,000.

CHEMICAL BUILDING—Merrimac Chemical Co., Chemical Lane, Everett, Mass., awarded contract for a 1 story contact building, to Aberthaw Co., 80 Federal St., Boston, Mass. $60,000.

CHEMISTRY BUILDING—Miami University, A. T. Connar, Dir. of Public Works, Oxford, O., will soon award contract for a 3 story, 98 x 104 ft. chemistry building on Campus. Estimated cost $200,000. Garber & Woodward, 4 West 7th St., Cincinnati, O., are architects.

COKE OVENS—Consolidated Gas Co. of New York, 4 Irving Pl., New York, N. Y., plans the construction of coke ovens at Hunts Point Ave., East Bay and Bronx River. Estimated cost $250,000. J. F. Hunter, 4 Irving Pl., New York, is architect.

EXPLOSIVES PLANT—Liberty Explosives Corp., J. H. Lytle, Secy., 1406 Clark Bldg., Pittsburgh, Pa., plans the construction of a plant at Connellsville and Uniontown Highway, Uniontown. Private plans. Work will be done by separate contracts.

FIREWORKS PLANT—Unexcelled Mfg. Co., 22 Park Pl., New York, N. Y., negotiating for purchase of site for a fireworks plant at Cranbury, N. J. Estimated cost to exceed $100,000.

FACTORY (Galvanizing Room)—Flint & Walling Co., Kendallville, Ind., plans a 60 x 125 ft. factory. Estimated cost $42,000. Private plans.

GAS PLANT—City of Guthrie, Okla., voted $225,000 bonds for gas plant.

GAS GENERATOR BUILDING ADDITION—St. Louis County Gas Co., Webster Groves, Mo., awarded contract for the construction of a 1 story, 57 x 61 ft. addition to generator building to Woermann Construction Co., 1441 Syndicate Trust Bldg., St. Louis.

GAS and COKING PLANT — Fort William Gas Co., (subsidiary of Canadian Terminal System, Ltd., 1106 C.P.R. Bldg.) H. A. Johnston, Chief Eng., Toronto, Ont., will receive bids in September, for a gas and coking plant. Estimated cost $500,000.

GASOLINE REFINERY—Big Lake Oil Co., Big Lake, San Angelo, Tex., making plans for high pressure casinghead gasoline plant, capable of handling 50,000,000 cu.ft. gas daily, near Texon. Estimated cost $250,000.

GLASS PLANT—Pittsburgh Plate Glass Co., 5th and Wyandotte Sts., Kansas City, Mo., is having revised plans prepared for 1 story, 162 x 350 ft. warehouse and office. W. R. Bovard, 907 Orear-Leslie Bldg., Kansas City, Mo., is architect. Maturity, 1931.

GLASS BOTTLE PLANT—Marienville Glass Bottle Co., R. R. Underwood, Pres., Marienville, Pa., will soon award contract for the construction of a 1 story 100 x 200 ft. glass bottle plant to replace fire loss. Approximately 75% new equipment will be required. Estimated cost $100,000 Private plans.

GLASS TUBE PLANT ADDITION—Federal Brilliant Co., 3531 Washington Ave., St. Louis, Mo., awarded contract for 4 story, 33 x 37 ft. building to be used for studios and addition to glass tube plant at 3522 Washington Ave., to H. O. Hirsch & Co., Wainwright Bldg., St. Louis.

GLASSWARE FACTORY—Macalaster-Bicknell Co., 28 Wendall St., Boston, Mass., awarded contract for the construction of a 1 story, 55 x 100 ft. factory at Moore and Washington Sts. to R. Gleason, 304 Belgrade Ave., Rosindale. Estimated cost $40,000.

LABORATORY—Vacuum Oil Co., 61 Bway., New York, awarded contract for a 1 story, 50 x 120 ft. and 174 x 215 ft. laboratory at Paulsboro, N. J., to Turner Co., 1700 Walnut St., Phila., Pa.

LABORATORY—Dept. of Mines, Ottawa, Ont., awarded contract for an ore dressing and metallurgical laboratory at Booth St., Ottawa, to A. Garvock, Sparks St., Ottawa. $103,000.

LABORATORY — Hughes Development Co., 1001 North Orange Dr., Los Angeles, Calif., plans a 2 story and basement, 150 x 300 ft. laboratory. Engineer and architect not selected. Multicolor, Ltd., N. Dietrich, Pres., c/o owner, is lessee.

LABORATORY and CAMERA BUILDINGS—Universal Pictures Corp., Universal City, Calif., receiving bids 3 story, 76 x 150 ft. laboratory and 3 story, 26 x 125 ft. camera building. $180,000. H. H. Walker, c/o owner, is supervising architect.

LABORATORY—Harvard College, Cambridge, Mass., receiving bids for a 3 story and basement physics laboratory, on College Grounds. Estimated total cost $550,000. Coolidge, Shepley, Bulfinch & Abbott, Ames Bldg., Boston, Mass., are architects.

LABORATORIES—Harvard University, A. L. Lowell, Pres., Cambridge, Mass., is having revised plans prepared for the construction of a group of biological institution buildings including laboratories, research buildings, etc. at Oxford St. and Divinity Ave. Estimated cost $5,000,000. Coolidge, Shepley, Bulfinch & Abbott, Ames Bldg., Boston, Mass., are architects.

LABORATORY—Bd. of Trustees, Suffield School, Suffield, Conn., plans extension to school including dormitory, laboratory, etc. Estimated cost $1,000,000. Architect not selected.

LABORATORY—Midvale Co., 4300 Wissahicken Ave., Phila., Pa., plans the construction of a 2 story, 50 x 100 ft. laboratory and office at Roberts Ave. and Blabon St. United Engineers & Constr. Co., 112 North Broad St., Phila., Pa., are engineers.

LABORATORY—Lawrenceville School, c/o Delano & Aldrich, 126 East 38th St., New York, N. Y., is having plans prepared for the construction of a 2 story laboratory building at Princeton, N. J. Estimated cost $40,000.

LABORATORY—H. S. Bell, Woolworth Bldg., New York, N. Y., Archt., will award contract for a 1 story, 55 x 70 ft. laboratory at Sewaren, N. J. for Shell Eastern Petroleum Co. and Shell Union Oil Co., 65 Broadway, New York, N. Y. Estimated cost $40,000.

LABORATORY—Spang Chalfant Co., Clark Bldg., Pittsburgh, Pa. will soon award contract for a machinists and founders laboratory at Duss Ave., Ambridge, Pa. Private plans.

LABORATORY (Chemical) — University of Virginia, Richmond, Va., plans the construction of a group of buildings to include chemical laboratory $100,000, etc. Estimated total cost $700,000.

LABORATORY (Mechanical Engineering)—Virginia Polytechnic Institute, J. A. Burruss, pres., Blacksburg, Va., awarded contract for the construction of a mechanical engineering laboratory, to D. J. Phipps, Roanoke, Va. $250,000.

LABORATORY — Woods Hole Oceanographic Institution, F. Lillie, Pres., Woods Hole, Mass., awarded contract for a 3 story and basement, 60 x 140 ft. laboratory at Water St. to G. B. Macomber Co., 38 Chauncy St., Boston, Mass.

SCIENCE BUILDING — Hendricks College, Little Rock, Ark., plans the construction of a 3 story and basement, 100 x 200 ft. chemistry, physics and biology building at Conway, Ark. Estimated cost $140,000. Wittenberg & Deloney, Home Life Bldg., Little Rock, Ark., are engineers.

LEATHER FACTORY—Lucius Beebe & Son, 129 South St., Boston, Mass., awarded contract for a 6 story, 75 x 125 ft. warehouse and storage building on South St. to J. F. Griffin Co., 250 South St., Boston. Estimated cost $50,000.

MINING and METALLURGICAL BUILDING—University of Toronto, Queens Park, Toronto, Ont., plans a 4 story and basement addition. Estimated cost $250,000. Craig, Madell & L. R. Laudon, 96 Bloor St. West., Toronto, are engineers.

MINING MILL—McIntyre Porcupine Mines, Ltd., Standard Bank Bldg., Toronto, Ont., plans a 2,000 ton mill including milling and concentrating equipment, electric power, etc., for gold mining near old site in Schumaker, Ont. Estimated cost $500,000. Private plans.

SMELTING PLANT — Bureau of Yards & Docks, Navy Dept., Wash., D. C., will soon let contract for a 1 story, 57 x 102 ft. smelting plant. Specification 6124.

SULPHUR MINING PLANT—Freeport Texas Co., c/o E. L. Norton, Pres., 52 Wall St., New York, making plans for increasing capacity of sulphur mining plant, by 30%, at Freeport, Tex. Improvements to include methods of treating water supply, use of flue gases for preheating feed water and various other engineering economies as recommended by Research engineers.

CEMENT DISTRIBUTING PLANT — Marquette Cement Manufacturing Co., R. W. Meyer, Local Manager, 1623 Arcade Bldg., St. Louis, Mo., receiving bids 5 rein.-con. additional silos for storage of cement for plant at foot of Malt St. Estimated cost $75,000. Private plans.

CEMENT MANUFACTURING PLANT—St. Louis Portland Cement Co., c/o C. Boettcher, Pres. of the Ideal Cement Co., Denver National Bank Bldg., Denver, Colo., making preliminary plans for the construction of cement manufacturing plant for production of portland cement under wet process, 4,000 bbl. daily capacity, including two kilns, crusher plant, etc. Estimated cost approximately $2,000,000.

POTTERY PLANT—Salem China Co., F. H. Sebring, Salem, O., will receive bids about July 19 for the construction of a 1 story, 50 x 150 ft. factory also to install tunnel decorating kiln. Estimated total cost $65,000. Private plans.

POTTERY PLANT—Trenton Potteries Co., North Clinton, Trenton, N. J., awarded the general contract for a 1 story and basement addition on North Clinton Ave. between Ott St. and Dewey Ave., to Karns & Smith Co., Inc., Broad Street Bank Bldg., Trenton. Estimated cost $40,000.

TILE FACTORY—Albree Marble & Tile Co., Inc., 9 Ashland St., Dorchester, Mass., awarded contract for a 1 story, 100 x 100 ft. factory at Mt. Vernon St. and Columbia Rd., Dorchester, Mass., to I. H. Bogart Co., 60 State St., Boston. Estimated cost $50,000.

OIL COMPOUNDING PLANT—The Quaker Petroleum Co., 14th and Nicholas Sts., Omaha, Neb., will receive bids until about Aug. 1, for a 56 x 210 ft. oil compounding plant and 60 x 96 ft. barreling plant at 20th and Hickory Sts. J. G. McArthur, 307 Keeling Bldg., Omaha, Neb., is architect.

OIL MILL—De Soto Oil Co., 998 Kansas St., Memphis, Tenn., contract for the concrete foundation for a seed house, 130 ft. long, 100 ft. wide and 65 ft. high to J. C. Barker, Dermon Bldg., Memphis; and steel contract to Muskogee Steel Co., Muskogee, Okla. Estimated total cost $25,000. Work is under way.

OIL PLANT—Supreme Oil & Refining Co., 518 North Dela 402, Indianapolis, Ind., plans a 99 x 102 ft. plant. Estimated cost $41,000. Foltz-Osler & Thompson, 704 F. W. Wild Bldg., Indianapolis, are architects.

REFINERY (Copper)—Canadian Copper Refiners, Montreal, subsidiary of Nichols Copper Co., Washington St., Long Island City, N. Y., awarded contract for excavation for copper refinery at East Montreal to Kendall Bros., 1853 Iberville St., Montreal and steel to Canadian Vickers Ltd, Maisonveuve, Que. Estimated cost $2,000,000.

REFINERY—Gulf Refining Co., H. Henderson in charge, Frick Bldg., Annex, Pittsburgh, Pa., plans the construction of a refinery on 120-acre site in Neville Island, Pa. Estimated cost $1,500,000. Private plans.

REFINERY (Oil)—Texas Co., Port Arthur, Tex. and 135 East 42nd St., New York, plans the construction of oil refinery. Estimated cost $600,000. Private plans. May use day labor.

OIL REFINERY—MacMillan Petroleum Corp., C. C. Benz, Asst. Supt., El Dorado, Ark., and 530 West 6th St., Los Angeles, Calif., awarded separate contracts for the oil refinery in Norphlet, Ark. Estimated cost approximately $250,000.

REFINERY—A. G. Spaulding & Co., Chicopee, awarded contract 1 story, 60 x 200 ft. refinery, to W. A. Newton Co., Mill River Lane, Springfield, Mass. Estimated cost $40,000 to $50,000.

COMMERCIAL PIGMENT PLANT—Commercial Pigments Corp., Curtis Bay, Md., and 230 Park Ave., New York, manufacturers of titanium dioxide, a paint ingredient, awarded contract several additional plant buildings, to United Engineers & Contractors, 112 North Broad St., Phila., Pa. Approximately $200,000.

DRY COLOR FACTORY—United Color & Pigment Co., Evergreen Ave., Newark, N. J., manufacturers of dry color and lithophone, awarded contract for altering and constructing a 3 story, 50 x 105 ft. addition to factory at 158 Mt. Olivet Ave., to Adams-Faber Co., 247 Lorrine Ave., Upper Montclair. Estimated cost $45,000. This corrects report in June issue.

PAINT and VARNISH FACTORY—Paragon Paint & Varnish Co., 47 10th St., Long Island City, N. Y., will not construct factory at 10th St. and Vernon Ave. Estimated cost $75,000. L. A. Abramson, 46 West 46th St., New York, N. Y., Archt. Project in abeyance.

PAPER PLANT—Rising Paper Co., L. R. Howes, c/o Strathmore Paper Co., West Springfield, Mass., plans a 3 story, 85 x 175 ft. finishing building at Great Barrington. Estimated cost $100,000.

WALL PAPER PLANT — Becker Smith & Page, Water and Snyder Sts., Philadelphia, Pa., will soon award contract for a 2 and 3 story, 117 x 305 ft. factory for the manufacture of wall paper. Ballinger Co., 12th and Chestnut Sts., Philadelphia, is architect.

PAPER PLANT—Bogalusa Paper Co., R. H Laftmen, Genl. Mgr., Bogalusa, La., awarded contract for a 2 story and basement, 43 x 335 ft. unit to plant for the manufacture of kraft paper, to H. J. Cowgill, Bogalusa, $40,000. Total estimated cost including equipment $1,000,000.

SOAP FACTORY — Colgate Palmolive Peet Co., 17th St. and Kansas Ave., Kansas City, Kan., awarded contract for a 25 x 25 ft. factory, 135 ft. high, to Kansas City Structural Steel Co., 21st St. and Metropolitan Ave., Kansas City, Mo. Estimated cost $100,000.

SOAP FACTORY—Los Angeles Soap Co., 617 East 1st St., Los Angeles, Calif., awarded contract for a 1 story, 40 x 340 ft. soap factory on Morshon Island, near Los Angeles, to Griffith Co., Los Angeles Ry. Bldg., $50,000.